



Z Technology
DVS5100
USER MANUAL
Version 2.17

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Table of Contents

TABLE OF CONTENTS	I
SECTION 1: SPECIFICATIONS.....	1-1
System Specifications	1-1
SECTION 2: PRODUCT OVERVIEW.....	2-1
Overview:.....	2-1
Data Collection and Dot Plot Mapping:	2-1
Swept Spectrum Capability:	2-1
Mixed Signal and Adjacent Channel Measurements:	2-2
Summary:	2-2
SECTION 3: SYSTEM SETUP & OPERATION.....	3-1
Introduction	3-1
Location of System Components	3-2
Power up the Computer	3-2
Power up the Field Strength Meter	3-2
Tool Tips.....	3-3
START and USE the DRIVE TEST Application Software	3-3
Drive Test Menu Selections	3-4
DriveTest Toolbar	3-5
Comment Prompt	3-6
Drive Test Collecting Data.....	3-7
Job Editor Introduction	3-7
Edit Job & New Job buttons	3-7
New Job Wizard: first page	3-8
New Job Wizard: second page.....	3-9
File Management.....	3-10
Job Editor: Frequency List.....	3-10
Job Editor - Frequency List	3-11
Create New Frequency/Signal Type	3-11
Job Editor - Settings	3-12
Job Editor - Help Tab	3-13
Job Editor: Configure Analog	3-14
Data Tab with Mixed Signal Types.....	3-15
Plot Tab	3-16
Map Tracking Settings Button.....	3-17
Map Properties Button	3-19
Add Transmitter Button.....	3-21

Plot Tab: Properties - Name List	3-24
Plot Tab: Properties - Figures of Merit	3-25
Plot Tab: Drill Data - Single Point.....	3-26
Plot Tab: Drill Data - Multiple Points.....	3-27
Spectrum Monitor	3-28
Spectrum Monitor, Recording Mode, of an 8VSB Broadcast Signal.....	3-29
Spectrum display of FM Broadcast Signals	3-30
Spectrum Display	3-30
Time Plot of Integrated Power.....	3-32
SECTION 4: DATA EXPORT, MAPPOINT IMPORT	4-1
Using the Lat/Lon Exporter.....	4-1
Using the Optional MapPoint Post Process Map	4-3
SECTION 5: MAINTENANCE	5-1
Introduction	5-1
Wiring Diagram.....	5-2
Directory Structure	5-3
SECTION 6: OPTIONS & ACCESSORIES	6-1
Options	6-1
Accessories	6-1
SECTION 7: APPENDIX A.....	7-1
Field Strength Meter Remote operation	7-1
GPS Trouble Shooting	7-1
Drive Test Data Format	7-1
Field Definitions:	7-2
Sample .dto file	7-3
SECTION 8: APPENDIX B.....	8-1
Installing Third Party ESRI Map Data.....	8-1
General Description	8-1
Digital Map Data Sources	8-1
DriveTest Digital Map.....	8-2
Requirements for Digital Map Data.....	8-3
Naming Convention	8-4
Region Naming Convention	8-5
Data Location	8-5
Data Installation	8-12
MapData Verification.....	8-13

Section 1: Specifications

System Specifications

SYSTEM SPECIFICATIONS	
System Power Requirements	12VDC at 3.5AMP (or 120/220VAC)
Power Inverter	12V DC input, 120V AC output, 150 watts
Certifications	UL CSA
System Dimensions	216 mm (8.5 in) High 375 mm (14.75 in) Deep 470 mm (18.5 in) Wide
System Weight	13.9 Kg (25 lbs.)
R-507 FIELD STRENGTH METER SPECIFICATIONS	
Frequency Range	5 to 1000 MHz contiguous coverage
Measurement Range	-10 dB μ V to + 90 dB μ V (-117 dBm to -17 dBm) Utilizing auto-ranging plus front panel RF AMP controlled gain setting
Measurement Accuracy ^{1, 2, 3}	+/-2 dB @ 25 degree +/- 10 degree C Typical: Sweep Mode and Temperature = 0 to 50 degree C
Image Rejection	60 dB typical, High Sensivity mode
Detuning Characteristics	40 dB typical; for undesired signal 2x IF BW away from center frequency
Third Order Intercept	Preamp ON typ. 0 dBm Preamp OFF +20 dBm
Noise Figure	Preamplifier NF = 7 dB typical when RF AMP is selected
Audio Detection	AM or FM to internal speaker selected from front panel Rear panel connection for remote speaker or headphone. BW is 300 Hz to 3 kHz

Sensitivity	FM detection: 1 μ V for 12 dB SINAD typical AM detection: 1 μ V for 12 dB S/N typical
Measurement Resolution	0.1dB
Output Linearity Range	Continuous measurement range of 80 dB
IF Bandwidth	Narrowband = 15 KHz Wideband = 150 KHz
Input Impedance	50 Ohm
Operating Temperature	+10 to +40 Deg. C. 0 °C to +50 Deg. C (R-507 & GPS Rx)
GPS RECEIVER: TECHNICAL SPECIFICATIONS	
Primary Power	+9 to +32 VDC input
Power consumption (nominal)	80 mA, 0.95W, at 12V, 25 °C, with antenna
Back-up power	+3 to +12V DC (2.2 microamps @ +3.5V, 25 °C)
Serial ports (2)	RS-232
I/O Protocol options	TSIP (Trimble Standard Interface Protocol) @ 9600 baud, 8-Odd-1 TAIP (Trimble ASCII Interface Protocol) @ 4800 baud, 8-None-1 NMEA 0183 v2.1 @ 4800 baud, 8-None-1 RTCM SC-104 @ 4800 baud, 8-None-1
NMEA messages	Standard: GGA and VTG Optional: User-selected combination of GGA, GLL, VTG, ZDA, GSV, GSA and RMC; user can store configuration in non-volatile memory.
GPS RECEIVER: PHYSICAL CHARACTERISTICS	
Dimensions	

Metal enclosure	4.03" D x 4.97" W x 1.1" H (102mm x 127mm x 28mm) (excluding mounting flange)
Mounting flange	4.03" D x 6.81" W x 0.062" H (102mm x 173mm x 2mm)
Weight	0.57 lb. (0.26kg) (board + enclosure + flange)
Connectors	
Antenna	SMB
Serial data (2)	DB9
Power	3-pin Conxall
GPS RECEIVER: ACCESSORIES	
GPS antenna	Compact, active micropatch antenna with 5-meter cable and magnetic mount. 1.60" x 1.90" x 0.55" high (40.6mm x 48.3mm x 13.9mm)
GPS RECEIVER: PERFORMANCE SPECIFICATIONS	
General	L1 frequency, C/A code (SPS), 8-channel continuous tracking receiver, 32 correlators
Update rate	1Hz (TSIP, NMEA, or TAIP)
Accuracy	Position: 25 m CEP (50%) without S/A
	Velocity: 0.1 m/sec without S/A
	Time: 95 nanoseconds RMS (over-determined clock mode)
DGPS accuracy	Position: 2 m CEP (50%)
	Velocity: Velocity: 0.05 m/sec
Acquisition (typical)	Cold start: <130 seconds (90%)
	Warm start: <45 seconds (90%)
	Hot start: <20 seconds (90%)

	Cold start requires no initialization. Warm start implies last position; time and almanac are saved by back-up power. Hot start implies ephemeris also saved.
Reacquisition after signal loss	< 2 seconds (90%)
Dynamics	
Altitude	18,000 m
Velocity	515 m/sec maximum
Acceleration	4g (39.2 m/sec ²)
Motional Jerk	20 m/sec ³
Operational limits	Altitude <18,000 m or velocity <515 m/sec. Either limit may be exceeded but not both
GPS RECEIVER: ENVIRONMENTAL SPECIFICATIONS	
Operating temperature	-40 °C to +85 °C
Storage temperature	-55 °C to +100 °C
Vibration	0.008 g ² /Hz 5Hz to 20Hz
	0.05 g ² /Hz 20Hz to 100Hz
	-3dB/octave 100Hz to 900Hz
	Note: Specifications comply with SAE J 1211 requirements
Operating humidity	5% to 95% R.H. non-condensing, @ +60 °C
Altitude	Up to 18,000 m
Power Requirements	+6 to 20V at 500Ma.
COMPUTER	
Laptop Computer	Pentium class, 600 MHz, 64 Mb Memory, 12 G-byte Hard Drive, or better

- ¹ Some types of modulation influence measurement accuracy. For instance, with Video modulation, the R-505C measures the signal level of the Vertical Sync Peak. This adds 0.5 dB of addition uncertainty, widening the spec to +/- 2.5 dB.
- ² Each instrument is verified to be within the stated accuracy specification shown above as referenced to a CW signal. Each instrument is also calibrated over temperature to provide added accuracy through the range of 0 to 50 Deg. C.
- ³ Stated accuracy numbers are referenced to an accurate signal source. The signal source itself has NIST traceable accuracy. It attributes no more than +/- 0.5dB additional error to the above specification. All inaccuracies are additive including reference signal source inaccuracy and the above measurement numbers.

Section 2: Product Overview

Overview:

The DVS5100 is a Windows based Digital Television and Radio Signal Mapping System. The product is a unique RF field strength and digital parameter mapping system. Using this Windows based system, a Broadcaster can easily generate signal strength measurements and full sets of RF figure-of-merit parameters for Digital signals and map these over a service area.

The turnkey suitcase sized system includes a Z Technology precision Field Strength Meter, GPS receiver & antenna, DC power inverter, a state-of-the-art laptop PC and factory installed proprietary Drive-Test Applications Software. The Drive-Test Application integrates three separate yet related applications: Data Collection, Dot Plotting, and Swept Spectrum Analysis.

The system takes advantage of Z Technology's RF measurement expertise to produce precision, high-speed digital signal measurements under automated PC control. When used with a calibrated antenna system (provided as separate options), the DV5100 is a comprehensive facility offering precision RF power measurements for recording and documentation of signal coverage.

Data Collection and Dot Plot Mapping:

Data Collection automates the process of logging against GPS locations, several precise RF characteristics. The Data Collection application can be started before the vehicle is placed in motion. The system will initialize and begin accumulating data without further attention.

Live plotting of the GPS determined positions can be viewed while testing is in process and for many locations can be overlaid on maps. Upon completion of the drive test, a post measurement mode assigns colors to the dot trail of the driven path where colors correspond to signal strength, or any one of the selected RF figures-of-merit. For users in the United States, Z Technology has also developed translator software to overlay color-coded signal strength plots on commercially available digital street maps.

If desired, data can also be collected through a carefully planned methodology determined by the operator. The Data Collection Software allows a user to drive to a specific known locations, make a select number of measurements of all the chosen frequencies, pause the Drive Test System and move to the next location of interest. This process can be repeated as many times as needed to capture and characterize signal coverage. In this way measurements can be recorded only at desired reference locations. These data files will contain exclusive information only for the desired geographic positions.

Swept Spectrum Capability:

The Swept Spectrum Analysis portion of the system shows a unique live spectrum of the signals under test. The user may quickly look at a desired signal during data collection. The Swept Spectrum display is also useful in active viewing and analysis of band pass tilt, signal notches, and total power of digitally modulated signals. Under control of the system PC, the DVS5100 measures and displays total integrated power across a user defined bandwidth, peak in-band power, etc. These RF parameters are the same as those plotted against GPS locations via the mapping capability of the System Software.

Mixed Signal and Adjacent Channel Measurements:

Data for *Digital* & *Analog* television and radio signals can be measured and stored in data files all during the same Drive Test. This is an invaluable tool when working in mixed analog and digital signal environments found in the field today. In addition, the Swept Spectrum Display allows a user to examine adjacent channel occupancy and relative power levels of nearby signals.

Summary:

The new DVS5100 combines the functions of off-air field strength metering, accurate RF signal strength measurement, GPS position identification, and PC based automatic data collection & storage in one convenient lightweight system. Its small size permits transport as hand-carry airline baggage; easy temporary installation in a vehicle; quick setup at field locations; and portability to characterize RF and Digital signals at remote site.

Section 3: System Setup & Operation

Introduction

The DVS5100 system is pre-configured and ready to operate. All internal wiring is in place. To set up a system for operation:

1. Open the system case. The equipment will be as shown in figure 1 below.



Figure 1: Equipment in Operation

2. Connect the supplied GPS antenna to the GPS receiver located under the meter. A new system requires the GPS receiver to download data from satellites. A minimum of three satellites is required for Longitude and Latitude data. The GPS antenna must be located so that adequate satellite reception is possible. Inside buildings or tunnels will often result in lost satellite reception. Observe the lower right area of the Drive Test application for GPS performance.
3. Connect your selected receiving antenna to the field strength meter.
Note: If the system is to be operated from a vehicle, route the antennas to the rooftop. The GPS antenna has a magnet that will hold itself to the body of a metal vehicle. Avoid sliding the

antenna so not to scratch any paint. The receiving antenna selection and location for the field strength meter will depend upon the type of antenna and the type of work to be performed. This is the subject of a separate document.

4. Connect power to the system. If operation is from a vehicle, connect the DC power connector to the vehicle's power receptacle. If operation is from AC power mains, unplug the power connector from the AC power inverter located in the back of the pop-up case. See figure 2 for location of system components.

Location of System Components



Figure 2: Location of System Components

Power up the Computer

Turn on the Laptop by pressing and releasing the Power button. The COMPAQ logo appears followed by the Window 98 Desktop.

Power up the Field Strength Meter

Turn on the Field Strength Meter by pressing the red power switch located on front lower right side of the meter.

The Field Strength Meter needs to be placed in remote mode.

1. Press the Function button once.
2. Rotate the Tune Knob counter clockwise until "F93" appears.
3. Press the Tune Knob. "1 Port" will appear on the front panel display.

The meter is now in remote mode and ready for the operation of the Drive Test software.

Tool Tips

A Tool Tip is a short bit of information about various portions of the Drive Test program. By placing the cursor over many of the dialog boxes, buttons, and icons, a tool tip will appear. Tool tips are an aide to using the software application.

START and USE the DRIVE TEST Application Software

This section provides information on how to use the DRIVE TEST Application.

Start the Drive Test Program by double clicking on the DRIVE TEST shortcut  on the Desktop.

The program will start up and immediately start communicating with the Meter and GPS receiver. The Following screen will appear.

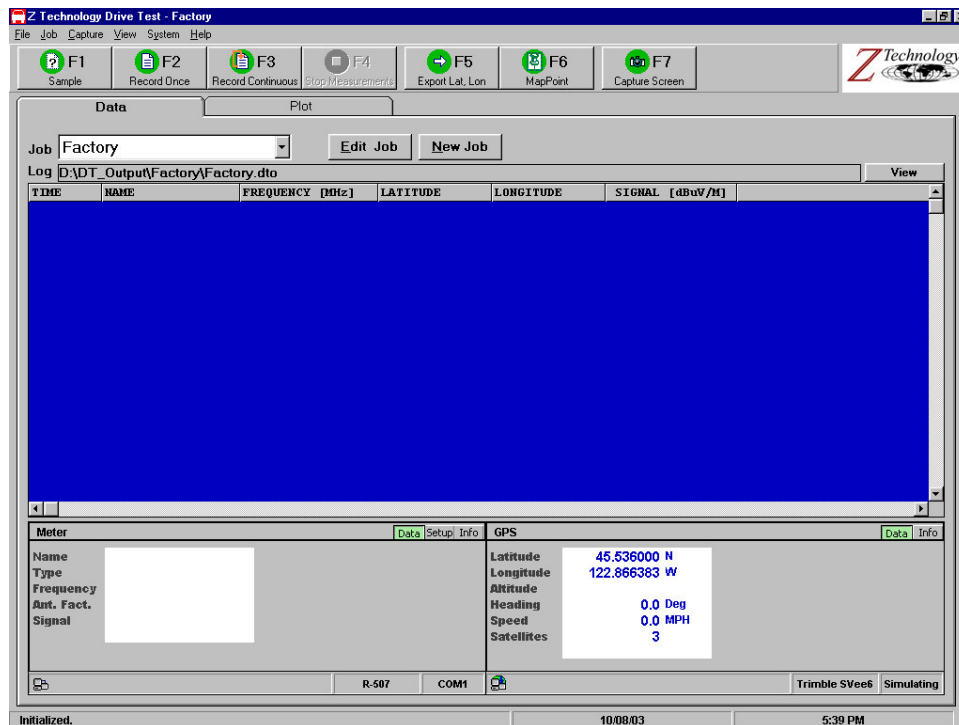


Figure 3: Drive Test program started

The top section of this screen shows large buttons labeled F1 through F7. These are used to control the primary functions of the Drive Test System. The buttons are described on the next page.

The next section below the function buttons includes a Data and Plot tab. With the Data tab selected as shown, the last 50 data records collected will display in the large blue section. The Plot tab allows the collected data to be plotted against a map. Each row is one data record.

The bottom of the screen is divided into two windows for each of the two RF devices that comprise the DVS5100 System. From left to right are Field Strength Meter (Meter) and GPS Receiver. Data measured for each device appears in each window when the data is collected. Note the GPS window is the only one with data because the GPS receiver is always active when power is applied. Data will appear in the Meter window as soon as one of the record buttons is pressed.

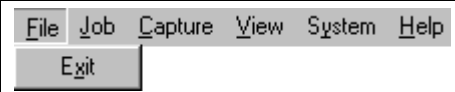
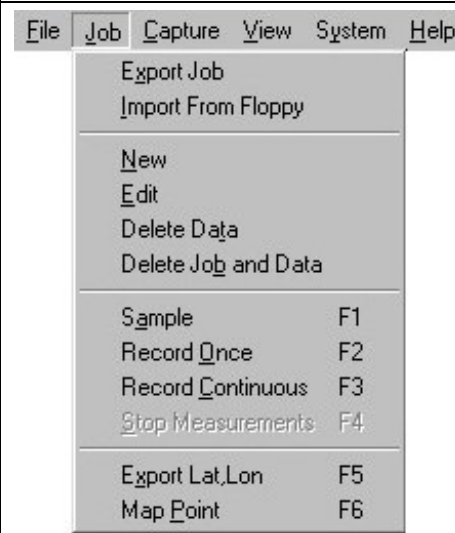
In the bottom left corner of each section is a communication status icon. Each icon blinks green with active communication for the device. When the program is started, all three communication icons will blink during system initialization. After initialization, the icons will only blink when there is communications with the respective device. There are Tool Tips for each icon that indicate the status of each device and direction of communication traffic where appropriate.

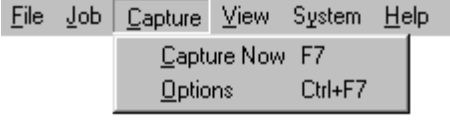
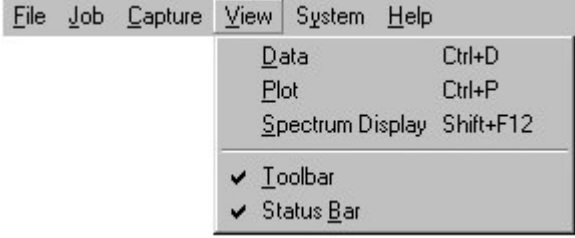
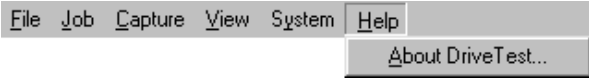
This system, as shown, is installed with option MA 04 Microsoft MapPoint USA. If this option or MA 05 Microsoft MapPoint Europe is not installed, the button labeled MapPoint will not be available.

Drive Test Menu Selections

The menubar at the top of the Drive Test screen has five menus.

They are: File, Job, Capture, View, System and Help. The following will describe features that are not available from the Function buttons. The function buttons are described following the menu description.

	File Menu ➤ Exit: This is used to close the Drive Test application.
	Job Menu ➤ Export Job: Writes the current Job file to a Floppy Diskette. ➤ Import From Floppy: Imports a Job file from a Floppy Diskette. ➤ New: Creates a new job. This action is also available from the Data tab. ➤ Edit: Allows the editing of an existing job file. This action is also available from the Data View. ➤ Delete Job and Data: Allows the user to delete the currently selected job file and all the data collected in that job. The Factory Job cannot be deleted. ➤ Delete Data: Allows the user to delete the data from the currently selected job file. Data from the Factory Job can be deleted. ➤ Export Lat,Lon: Starts up the Exporter, also available as a Tool bar button. ➤ Map Point: Starts up Microsoft MapPoint if installed and Authorized.

	Capture Menu ➤ Capture Now: See toolbar ➤ Options: Provides the user to options for SnagIt.
	View Menu ➤ Data: Selects the DATA view ➤ Plot: Selects the PLOT View ➤ Spectrum Monitor: Displays the spectrum monitor window ➤ Toolbar: Hides or shows the Toolbar. ➤ Status Bar: Hides or shows the status bar at the bottom of the Drive test window.
	System Menu ➤ Audio ON: Turns the Field Strength Meter audio on. ➤ Audio OFF: Turns the Filed Strength Meter audio off. ➤ Initialize: Initializes the hardware.
	Help Menu ➤ About: Provides information about Drive Test including the installed options.

DriveTest Toolbar

The following describes each of the Toolbar buttons. These buttons can be used by pressing the keyboard function keys or by using the mouse on the screen.

						
	Starts the measurement system using the active job file. Data is not recorded, only displayed on the Data tab. Measurements will be made once for each frequency in the active job file.					
	Measures and Records using the active job file. Measurements will be made once for each frequency in the active job file.					
	Continuously Measures and Records using the active job file.					
	Immediately stops all active measurements.					

	Starts the Exporter. Generic export allows the selection of any recorded data to be exported. If the MapPoint option is installed, data suitable for Microsoft MapPoint can also be exported.
	Starts the Microsoft MapPoint program which plots the exported data created in the step above.
	Provides the ability to gather screen captures using the integrated SnagIt program

To begin collecting measurement data, click the “Record Continuous” Button. The Factory Job file is already loaded when first started on a new system. The last job will be loaded on subsequent usage.

Comment Prompt

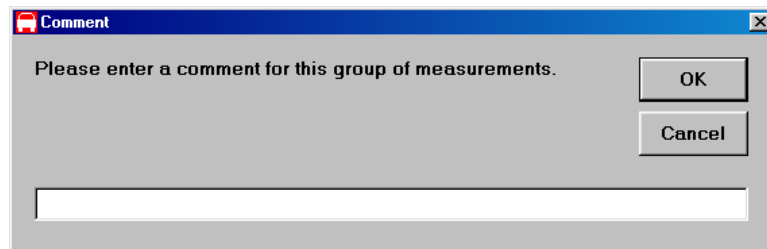


Figure 4: Comment prompt

The Factory job file is configured such that each time a recording is made it will be preceded with a user entered comment. Enter a comment in the comment screen or just click **OK** to continue. The prompt for comment can be disabled in the job editor. Cancel will cancel the start of data collection.

The measurement data (in this case, signal level measurements, GPS latitude and longitude information) is stored in "comma delimited text" Files. At a later time, the Files can be recalled and used to display Position-Location Color Plots of the Drive Test measured results on the PC screen.

Drive Test Collecting Data

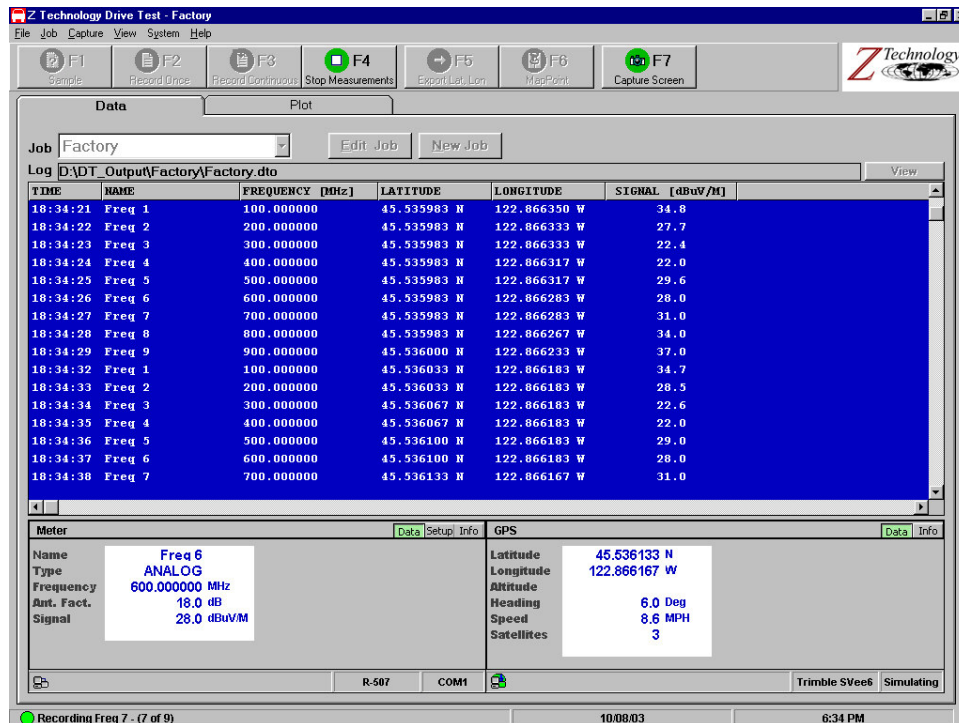


Figure 5: Drive Test program collecting data

As measurements are made, the results are displayed in a scrolling window as shown above. When the drive test is complete, exit the DRIVE TEST Program by selecting EXIT from the FILE menu or clicking on the X box in the upper right corner. Exiting will return you to the Windows Desktop.

Job Editor Introduction

The program keeps track of data by placing in unique folders on the local hard drive. A template is created that contains all the measurement parameters for each frequency to be measured. The template is called a job file and is created with the **Job Editor**. The job editor allows the frequency list to contain up to 50 entries per job file. Each job has a unique name and represents a group of user selectable meter settings and frequency list. If the program doesn't find any job files in the **C:\DT_Input** directory, it creates **FACTORY.JOB**. This file may be used as a template to create other job files by clicking on the EDIT JOB button.

Each job has an input file in **C:\DT_Input** with a **.job** extension. All output files are put in unique folders in **C:\DT_Output**. Each folder contains one data file (.DTO).

Edit Job & New Job buttons

The entire configuration to define a set of measurements is saved in a job file.

The Edit Job and New Job buttons allow the user to edit an existing job or create a new job respectively.

New Job Wizard: first page

The New Job button starts a wizard to create a new job. The first page is shown below.



Figure 6: First page of New Job wizard

This page lists the existing job files and provides for a new job file name. Enter a name of your choice in the dialog box and click the OK button. If an existing name is entered into the Job Name dialog box and the OK button is selected, you will be notified of the existing name and asked if you want to continue. If you answer **Yes**, the existing job will be erased and a new job created in its place.

New Job Wizard: second page

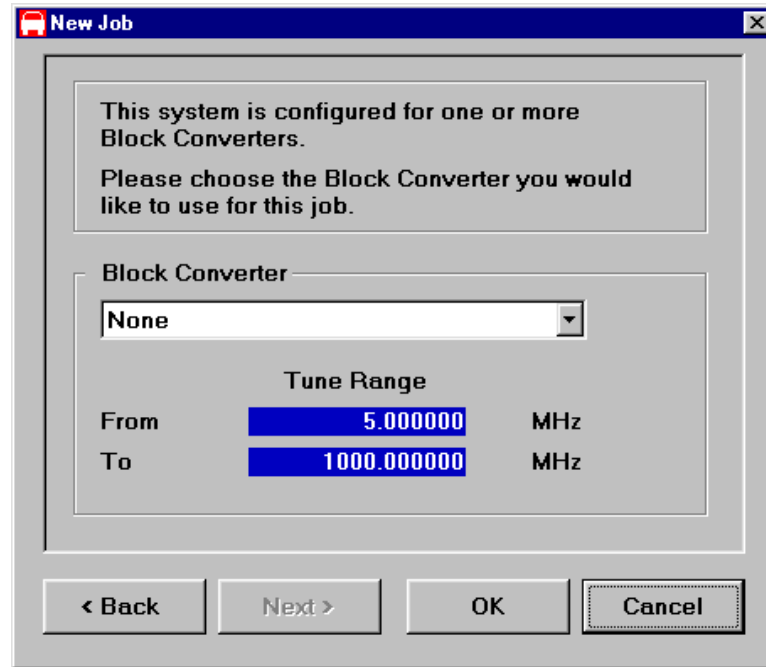


Figure 7: Second page of New Job wizard

The second page of the New Job wizard will only appear if a Block Converter option has been purchased. This page allows you to select the block converter that will be used when recording data.

File Management

See Figure 8. The buttons along the bottom of each Job Editor tab allow the user to either Save the current job, Save the current job to a new name, Delete the current job including all associated data or Cancel any changes made to the current job file.

Job Editor: Frequency List

The next set of figures show the various options on each of the Job Editor tabs.

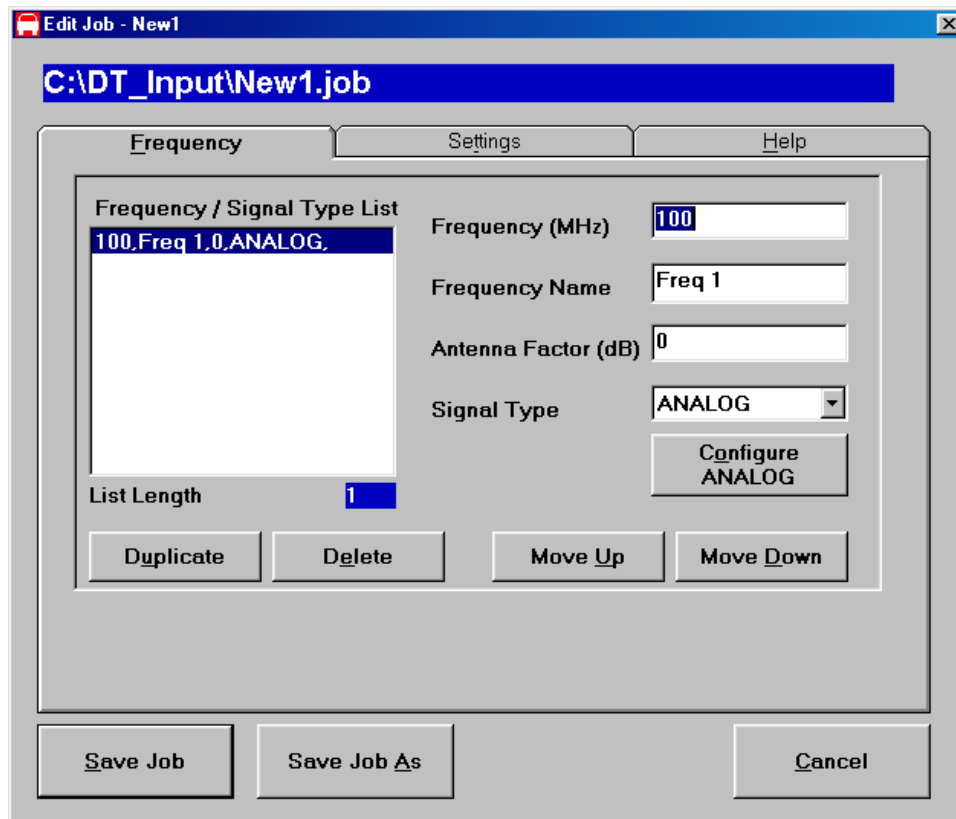


Figure 8: Job Editor with Frequency List tab selected

A new Job defaults to an initial frequency of 100MHz with a Frequency Name of Freq 1, Antenna Factor of 0, Signal Type of ANALOG as shown above.

The DVS5100 is able to handle various signal types automatically. Click in the Signal Type list above to see all the types supported. To add frequencies, select a frequency then press the Duplicate button. Change the parameters as necessary using the **Frequency (MHz)**, **Frequency Name**, **Antenna Factor** and **Signal Type** dialog boxes.

Signal Types include Analog, 8VSB, COFDM (8MHz), COFDM (7MHz), DAB, GSM, ISDB. Each Signal Type has a Configuration button.

Job Editor - Frequency List

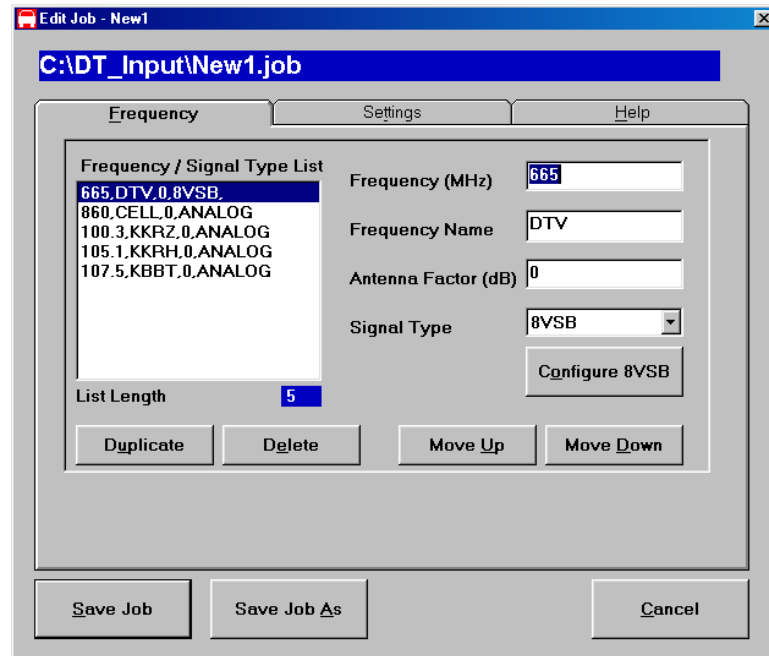


Figure 9: Job Editor with Frequency List tab selected

Duplicate creates a duplicate of the selected frequency that can be edited to change parameters. **Delete** is used to remove a frequency from the list. **Move Up** and **Move Down** allows the order of the frequency list to be changed.

Create New Frequency/Signal Type

- ◆ Select an entry from the Frequency / Signal Type List on the left. It may be easier to choose one that is close to your target entry.
- ◆ Press the Duplicate button.
- ◆ Change the parameters in the dialog boxes on the right. Frequency Name is an entry should be used to uniquely identify the frequency entered.
- ◆ Choose a signal type, then review the configuration of the signal type by pressing the **Configure** button below the Signal Type. Each signal type has specific Configure button that include a factory default that should be adequate for most applications.
- ◆ Arrange the order of measurements by selecting from the frequency list and use the Move Up or Move Down buttons.
- ◆ Select the Save Job button to save this job file or select Save As to create a new job file under a new name.

Antenna Factor: A positive number means that the combination of antenna and transmission line has loss. A negative number means there is gain. In most cases the number entered into this field should be a positive number. Only with an antenna and amplifier combination would a negative number be entered for antenna factor. . The unit of measure is dB.

Job Editor - Settings

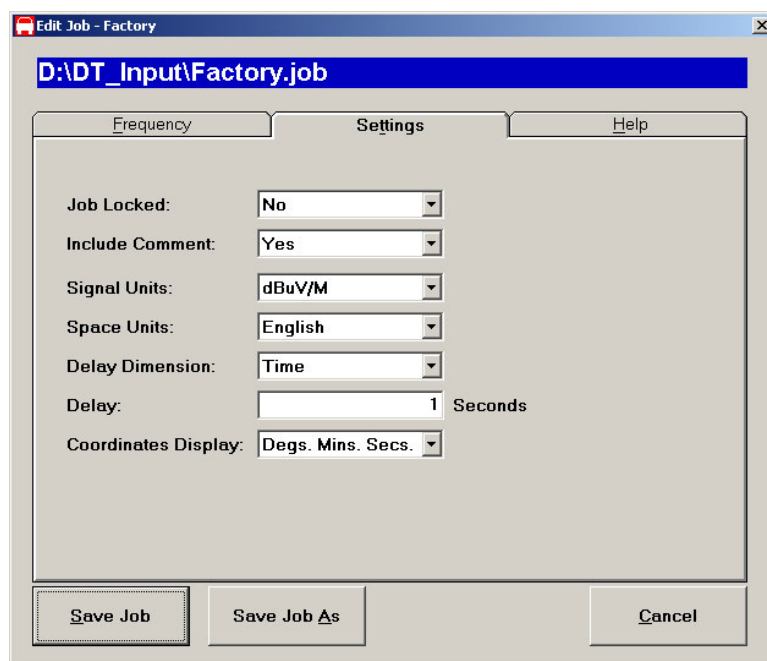
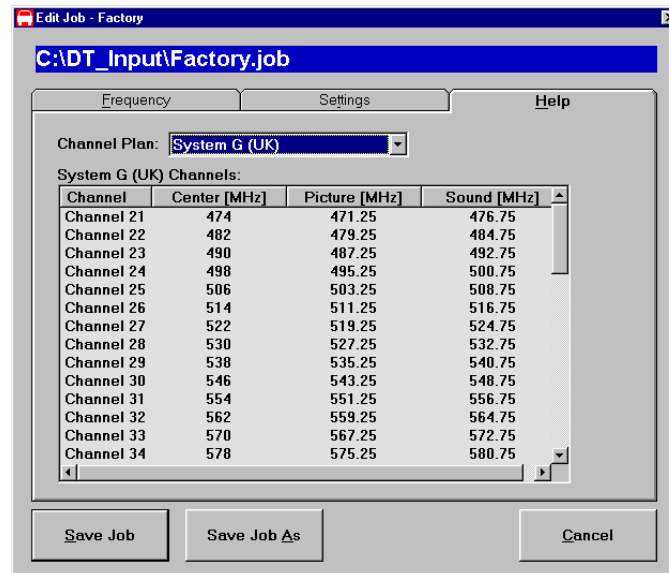
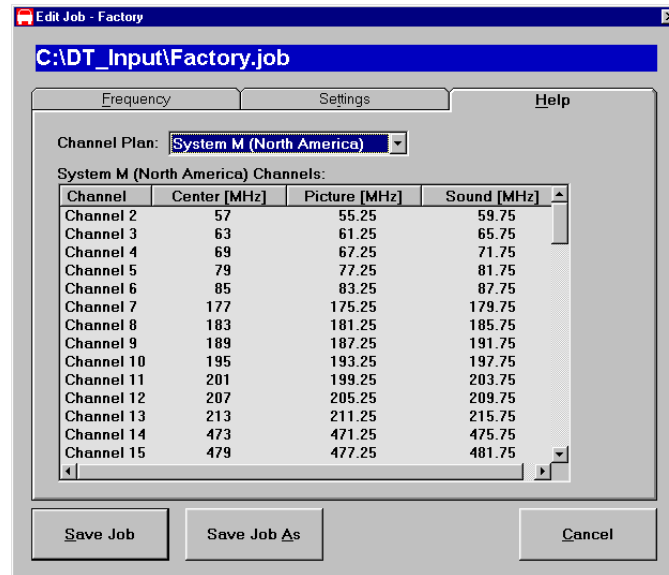


Figure 10: Job Editor with Settings tab selected

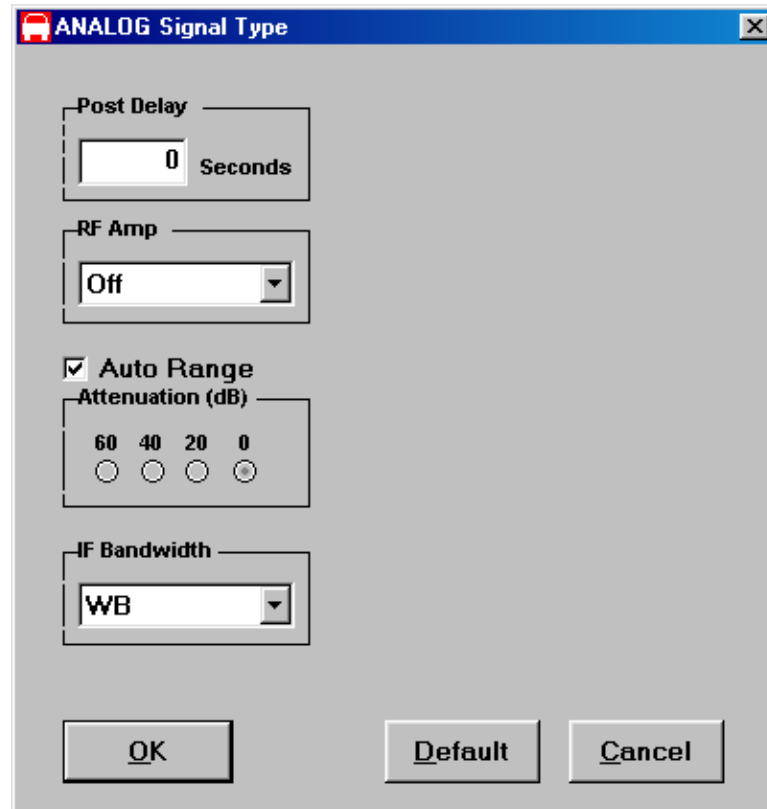
All information in each selectable item is a user definable configuration parameter.

- ◆ **Job Locked:** When locked, no further changes can be made to the specific job file. Locked is used to protect a completed job. When a job is locked, the Data tab will display a padlock to the right of the job name and the Record buttons are not available.
- ◆ **Include Comments:** Yes will prompt the user for a comment whenever a recording is started. These comments are included in the recorded data file.
- ◆ **Signal Units:** Selects the unit of measure for RF level data recorded in the data file. The choices are dBuV, dBm, dBuV/M. When dBuV/M is selected, the Antenna Factor entry is used. See figure 9.
- ◆ **Space Units:** The units of measure for distance. The choices are English, Metric, and Nautical.
- ◆ **Delay Dimension:** Allows the user to define the delay parameter between sets of measurements. The delay can be time based or distance based.
- ◆ **Delay:** A parameter to set the amount of time or distance as defined by the Delay Dimension. This delay is the time following a set of measurements, not the time between each measurement. See **Post Delay** on following pages.
- ◆ **Coordinates Display:** Allows the user to select the format for visual displays of GPS longitude and latitude on Drive Test PC screen presentations. Choices provided are in *Degrees, Minutes & Seconds* or *Decimal Degrees*. This format selection only affects the on-screen display format for GPS coordinates. It does not change the format used for file storage of GPS data. Data stored and recorded in files are always in Decimal Degrees regardless of the selection made here for Coordinate Display format.

Job Editor - Help Tab



The Help tab on the Job Editor provides a Channel Plan list for System M (North American), System G (United Kingdom), System B (Australia), and System I. This information is also available from the Help menu in the Spectrum Display.

Job Editor: Configure Analog

The image shows a software window titled "ANALOG Signal Type". It contains several configuration options: "Post Delay" with a text box set to "0" and the unit "Seconds"; "RF Amp" with a dropdown menu set to "Off"; "Auto Range" which is checked, followed by "Attenuation (dB)" with four radio buttons for 60, 40, 20, and 0 (the 0 button is selected); and "IF Bandwidth" with a dropdown menu set to "WB". At the bottom are three buttons: "OK", "Default", and "Cancel".

Figure 11: Analog Signal Type Configuration

If an Analog Signal Type is selected from the Frequency tab, The Configure Analog button becomes available. Selecting the Configure Analog button brings up this configuration window.

- ◆ **Post Delay:** Sets the delay following each individual frequency measurement.
- ◆ **RF Amp:** Allows selection of RF Amp On or Off.
- ◆ **Auto Range:** Allows the field strength meter to automatically select the proper gain for each measurement.
- ◆ **Attenuation:** Allows for manual selection of attenuation when Auto Range is not selected.
- ◆ **IF Bandwidth:** Allows the selection of wide (WB=150KHz) or narrow (NB=15KHz) IF filtering.

Data Tab with Mixed Signal Types

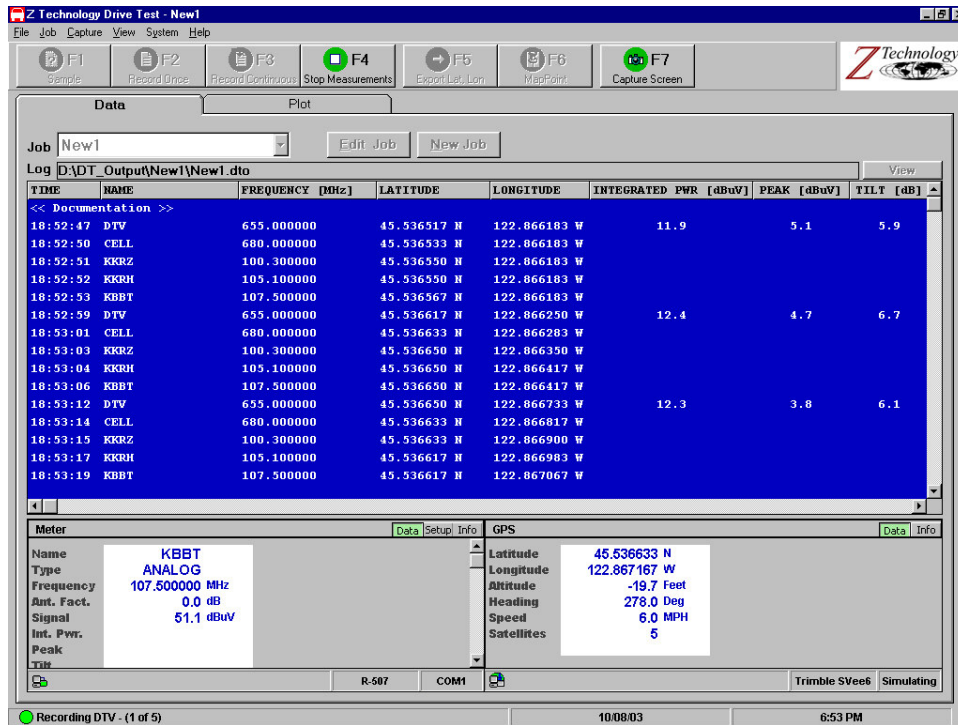


Figure 12: Sample of System Recording

This screen shows a sample job named NEW1. The system is collecting and recording data from a job file containing signals at several frequencies and two different signal types. Included in this job file are an 8VSB type signal from a DTV broadcast station, and four Analog type signals, a cellular signal at 860 MHz and three FM broadcast stations.

More information is available by scrolling the blue screen to the right using the scroll bar at the bottom of the blue screen.

The two windows near the bottom of the screen show the data being recorded from the RF hardware and GPS receiver.

Plot Tab

Selecting the PLOT tab on the Drive Test program will plot recorded data for the selected job. The plot properties are selected on the Properties tab.

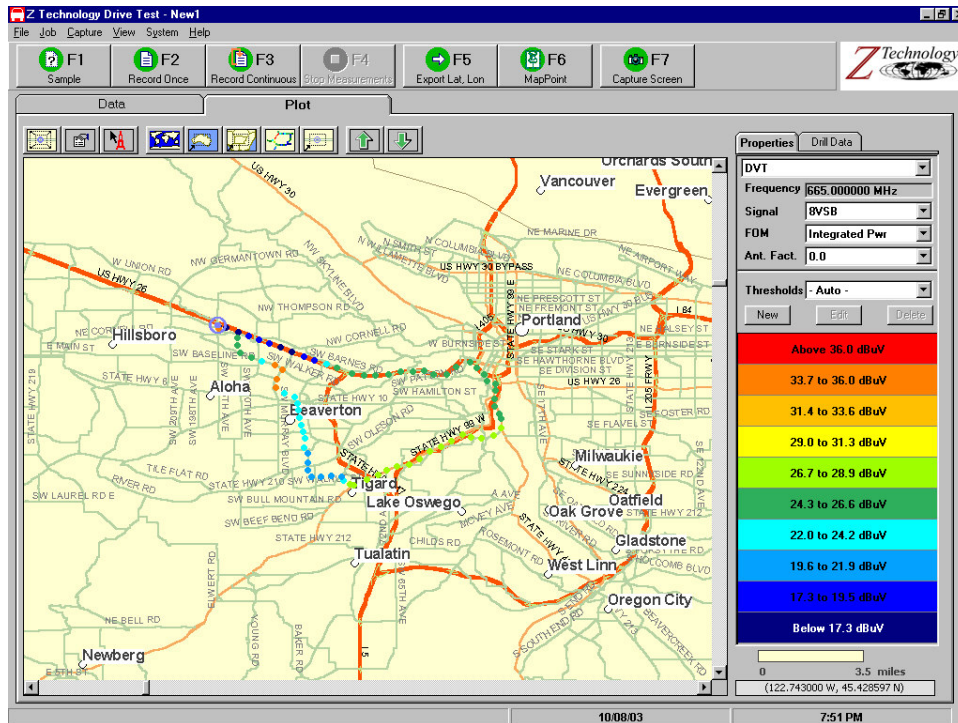


Figure 13: Dot Plot on map

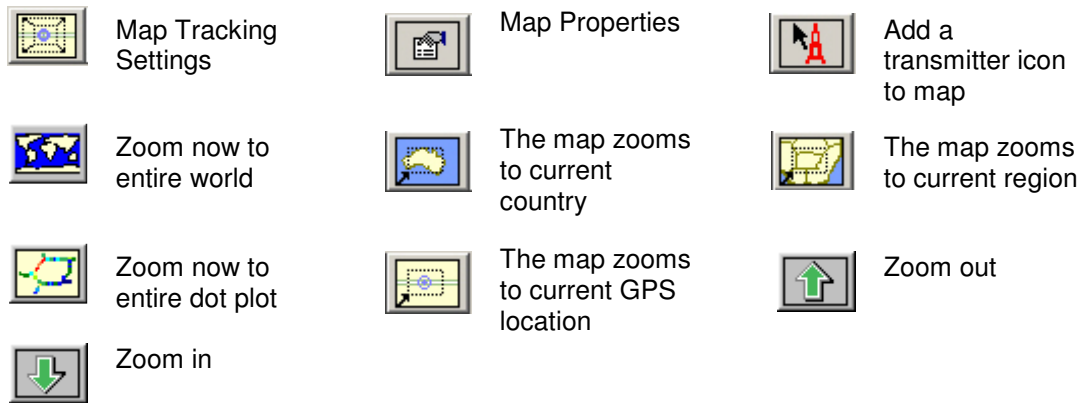
Using the mouse, the display can be zoomed in, out, panned up, down, left, or right. Some helpful actions are listed below.

Function	Key
Center at pointer	Double click anywhere within the map area
Expand an area	Left-Click and drag an area
Zoom out	Alt-Up arrow

Function	Key
Zoom in	Alt-Down arrow
Pan in small steps	Shift-Arrow
Pan in large steps	Ctrl-Arrow

The icons just above the map perform the following functions (left to right):





The left most three buttons of the Plot tool bar have many sub functions and require further explanation.

Map Tracking Settings Button



When the Map Tracking Settings button is selected the following screen appears.

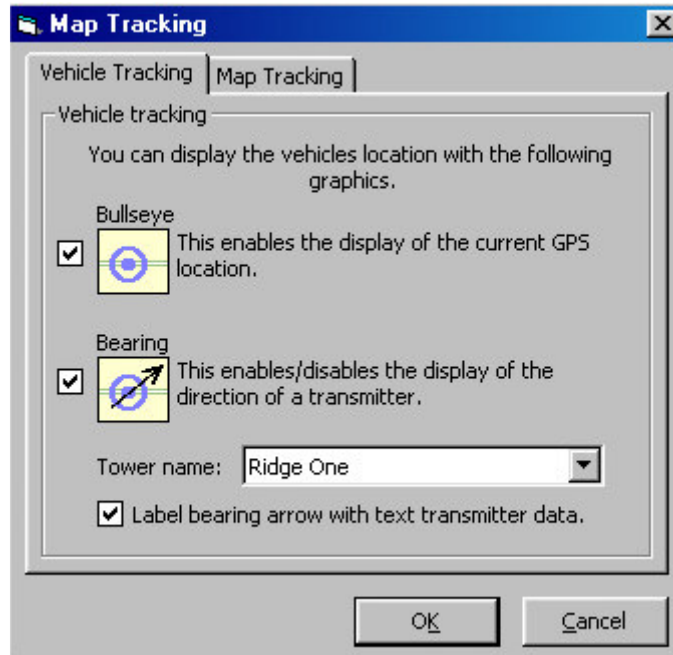


Figure 14: Map Tracking screen, Vehicle Tracking Tab

Two tabs will be seen to be accessible. The Vehicle Tracking tab allows the user to display the

present location through placement of a  "Bullseye" icon that will appear on the map at the

vehicle's present GPS location. This feature is selected by checking the box next to this icon. If this first icon or "Bullseye" is selected, the operator is then given a second option. That of enabling the



implementation of a "Bearing" Arrow provided to display the direction to a transmitter Tower. A further choice of Labeling the bearing arrow is provided. Checking all three boxes provided will enable all three Vehicle Tracking options. Note, a description of the steps necessary to enter a Tower is described in the "Tower Button" section later in this manual.

In this example we have checked the "Bullseye" box to enable the display of the current GPS location on the plot, we have checked the "Bearing" box to enable direction arrow to point at a transmitter, and we have selected a transmitter to point at in the Tower name field. Lastly we have checked the "Label Bearing arrow with text transmitter data" box to display the name of the tower we are pointing at on the plot next to the GPS location bullseye icon.

A second Tab providing additional options is the Map Tracking tab. This tab gives the operator the ability to adjust how the displayed map versus measured data interacts during drive testing.

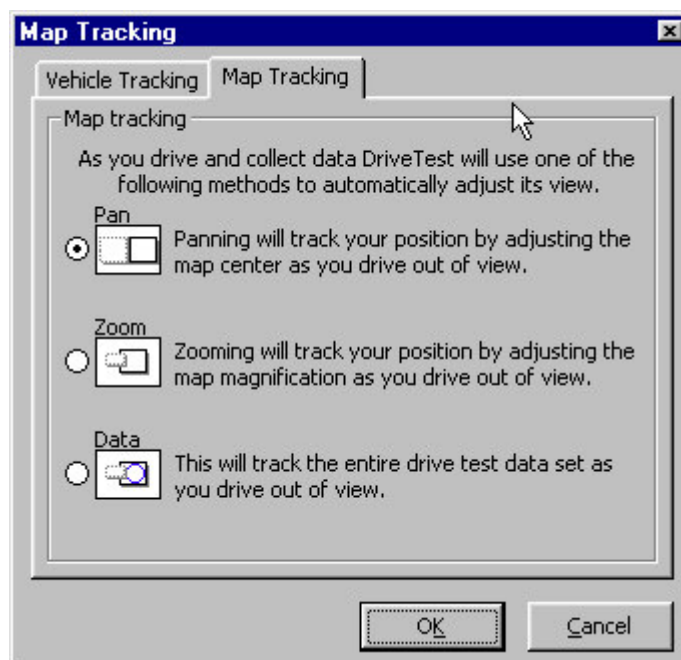


Figure 15: Map Tracking screen, Map Tracking Tab

Three options are provided each through selecting a unique icon:



Selection this option causes the map display to *Pan* the view when the vehicles driving off screen.



Selecting this option causes the map to *Zoom Out* when the vehicle drives off screen.



Selecting this option causes the map to *Zoom to the Entire Plot* when the vehicle drives off screen.

Select the desired method of automatic map adjustments by ticking the appropriate circle to the left of the desired icon.

Map Properties Button



Selecting Map Properties brings up the following window.

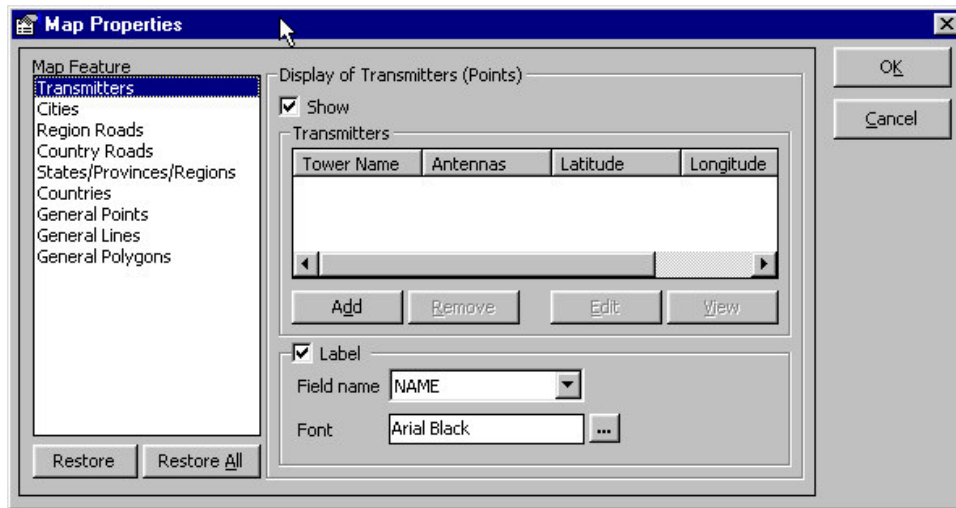


Figure 16: Map Properties screen, Transmitters Map Feature

The Map Properties button provides the user with powerful cartography options to change the look of the map by turning map features on or off and by changing map feature characteristics such as colors transparency or label fonts and font size.

Of the map features listed in the figure above, Transmitters, General Points, General Lines, and General Polygons are user supplied map features. Within the U.S.A. Region Roads are factory supplied as roads within States, and Regions factory supplied as State outlines. Outside the U.S.A. Region Roads and Regions are user supplied map data. General Points may be more cities, or perhaps points of interest. General Lines may be line type map detail for instance railroads. General Polygons may be bodies of water, lakes for instance. See Appendix B "Installing Third Party ESRI Map Data" for instructions on adding Region Roads, Regions, General Points, General Lines, and General Polygons to the map.

Transmitters are added to the map using the "Add Transmitter" button described in the "Add Transmitter Button" section later in this manual or by clicking on the Add button shown above then filling out the form on the resulting pop up screen.

Cities, Country Roads, States/Provinces, and Countries are factory supplied data. You may change the characteristic or appearance of this data by selecting the feature then manipulating its

characteristics in the resulting screen. For instance select the map feature “States/Provinces/Regions”. The following Map Properties screen appears.

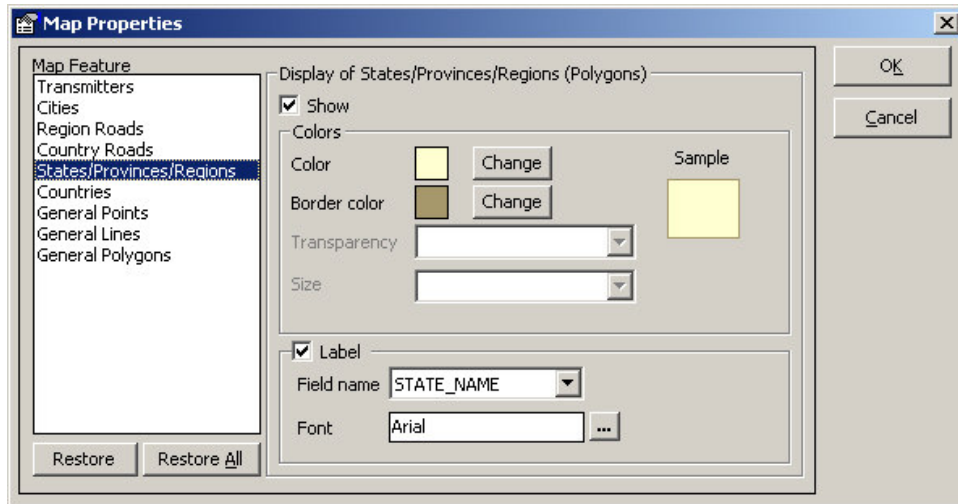


Figure 17: Map Properties screen, States/Provinces/Regions map feature

The middle portion of the screen labeled “Display of States/Provinces/Regions (Polygons)” allows the user to choose border colors, fill colors and if Labels are displayed. Double clicking on the appropriate square allows the user to modify the displayed colors. From the color palate that appears, choose a desired new color and click the OK button. When the Label box is selected, the user can determine the Field Name to be used as the Label. After making this choice, select the font style desired for use with on the Label. When all changes have been completed click the **OK** button to save the changes and return to the Plot Tab.

The **Restore** and **Restore All** buttons are useful and can be used for all windows in which they appear. As anticipated, the **Restore** button returns to default values, all Map Feature Properties for the highlighted Feature. The **Restore All** button does the same, but will affect the entire set of all Map Features.

Similar map feature changes can be made for other map features. For instance double click on the “General Polygons” map feature and the following screen appears.

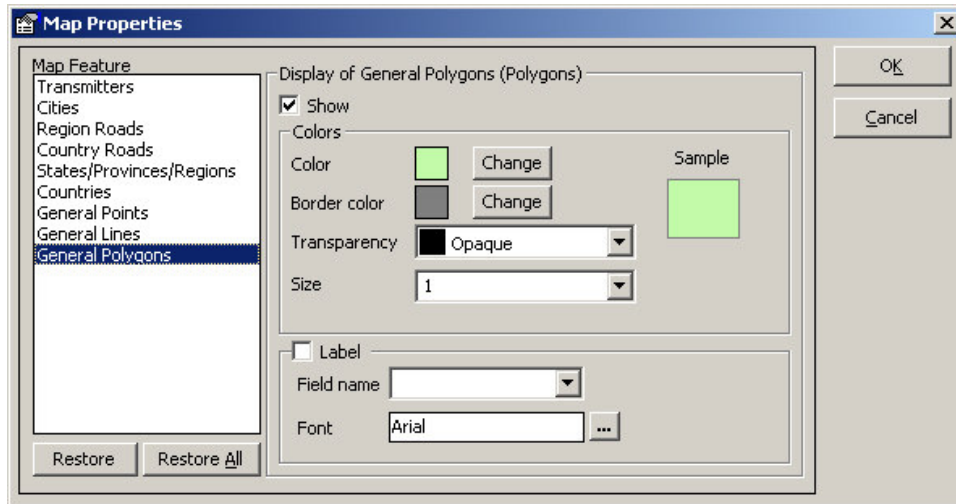


Figure 18: Map Properties screen, General Polygons map feature

This screen can be used to change the General Polygon display characteristics. Note that this applies only to user supplied data, that is of Type:Polygon but not a Region outline will be affected the same. See Appendix B for further explanation of user supplied ESRI Shape Files.

Add Transmitter Button



To add a transmitter to the plot, Click the **Add Transmitter** button, the mouse cursor changes from an arrow to a “+” marker as shown in the figure below. Using the Mouse move the “+” marker to the desired location of the transmitter then click.

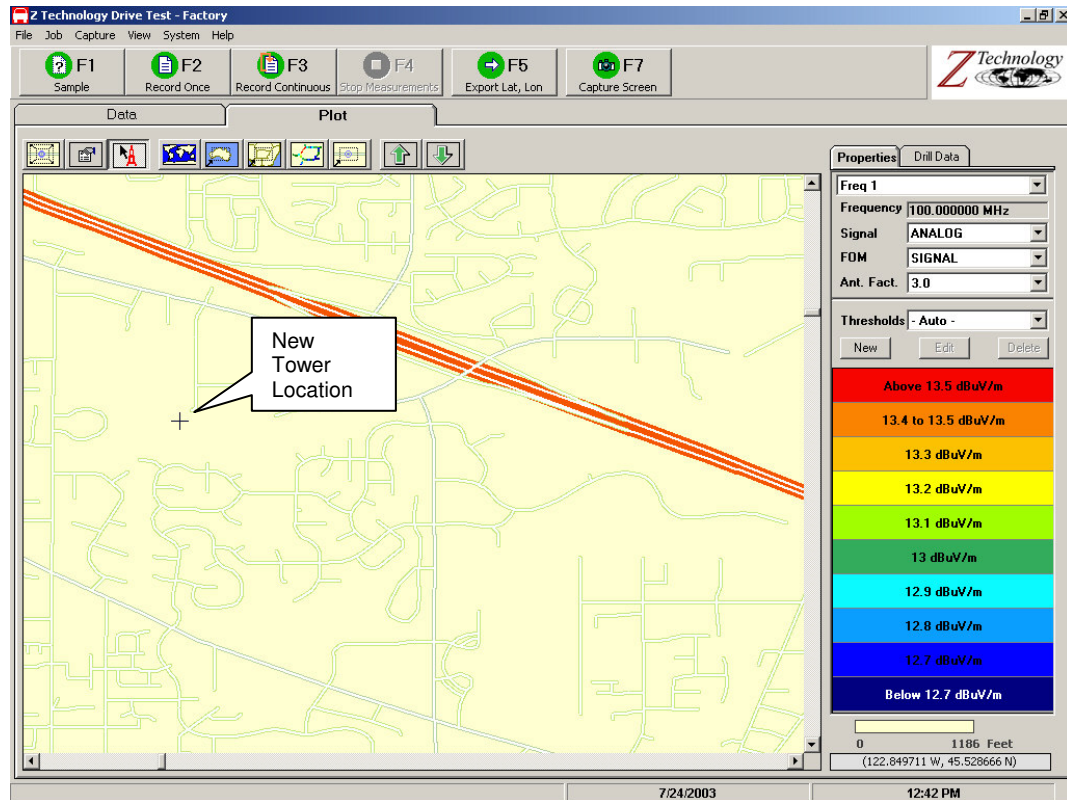


Figure 19: Placing a transmitter on the plot

Once a location has been selected by clicking the mouse, the screens below appear.

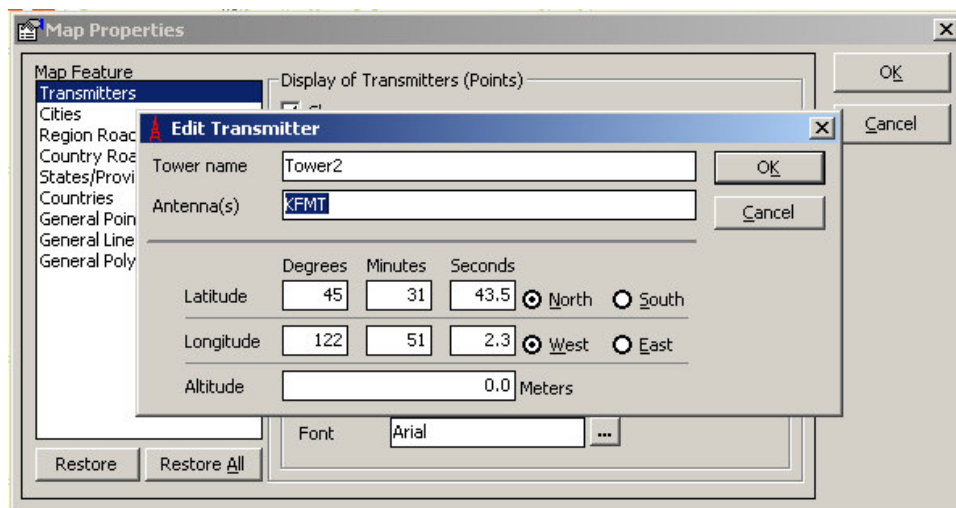


Figure 20: Edit Transmitter over Map Properties

The “Edit Transmitter” screen allows you to enter a name for the transmitter Tower in the “Tower Name” field and also call letters for the transmitter antenna in the “Antenna(s)” field. Note that there is provision for multiple transmitter antennas on a single tower. You may also edit the Tower GPS location. When all the correct information is entered click the **OK** button. This will close the Edit Transmitter. The Map Properties – Transmitter window remains. In the figure below we have added towers the first tower (TWRX_57Q) with two antennas (KOIN, and KOPB), and a Second tower (Tower2) with just one antenna, KFMT

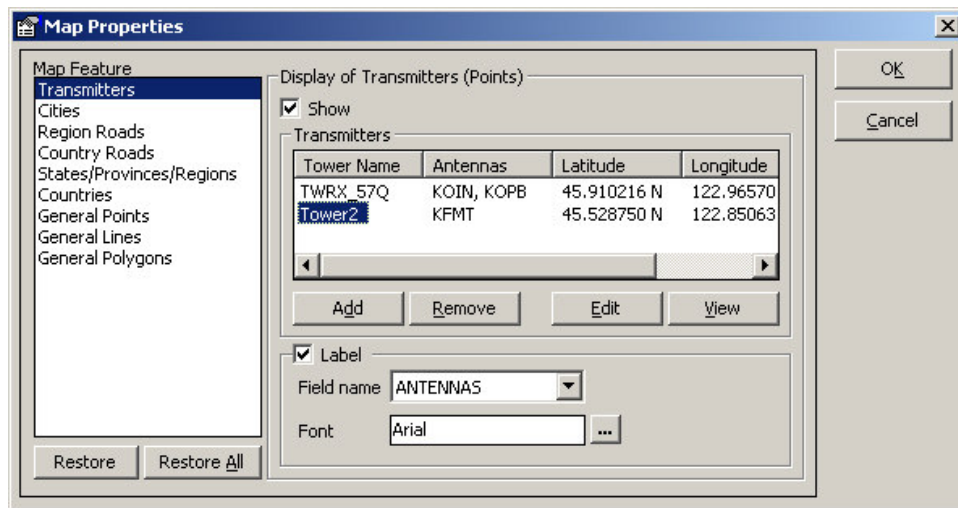


Figure 21: Map Properties - Transmitters

All towers regardless of where they are located will be listed here in the Map Properties – Transmitters screen. Check the **Show** box to display a Tower icon on the plot at the described GPS location. Check the **Label** box to enable the “Tower Name” or the “Antennas” to be displayed next to the Tower icon on the Plot. Under “Field name” select “NAME” to display the “Tower Name” or select “ANTENNAS” to display the “Antennas”.

To add another transmitter tower to the plot click the **Add** button here or go back to the Plot screen and click the **Add Transmitter** button.

To remove a transmitter click on the “Tower Name” of the unwanted transmitter to highlight it then click the **Remove** button.

To change any of the transmitter properties click the Transmitters “Tower Name” to highlight it, then click the **EDIT** button.

To pan the plot so that a transmitter is center screen, click the transmitters “Tower Name” to highlight it, then click the **View** button.

When finished adjusting transmitter properties, click the **OK** button to save all the settings, close the Map Properties screen and return to the Plot screen.

Plot Tab: Properties - Name List

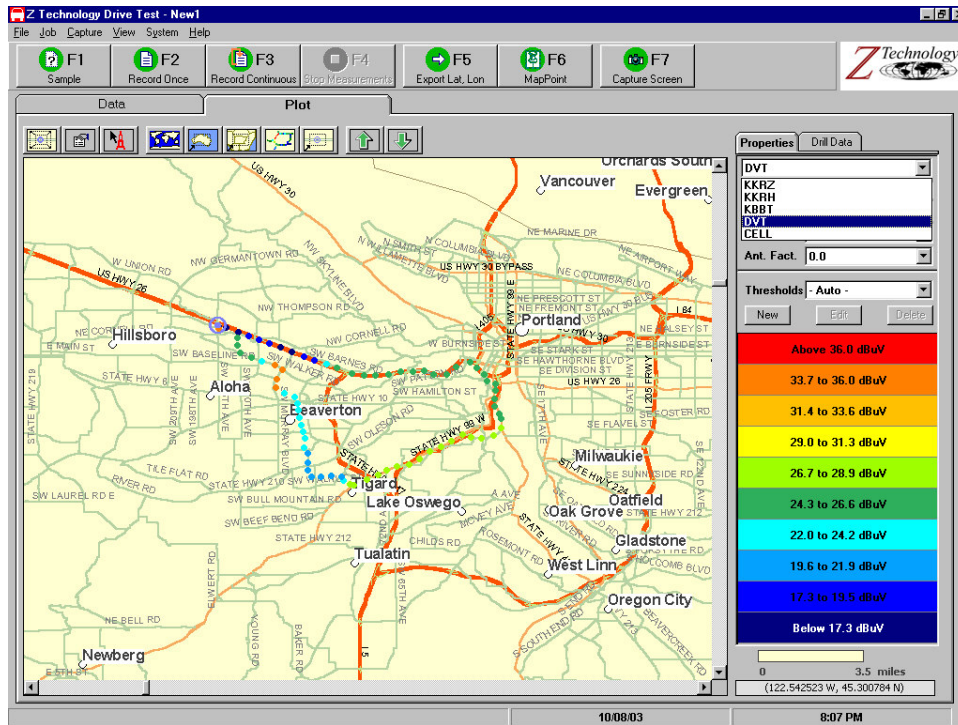


Figure 22: Plot Tab Name List

This screen shows a plot of the signal selected from the list on the Properties tab. Each frequency with all of its measured parameters can be independently plotted over a map. Selecting New or Edit can customize the palette shown at the lower right.

Plot Tab: Properties - Figures of Merit

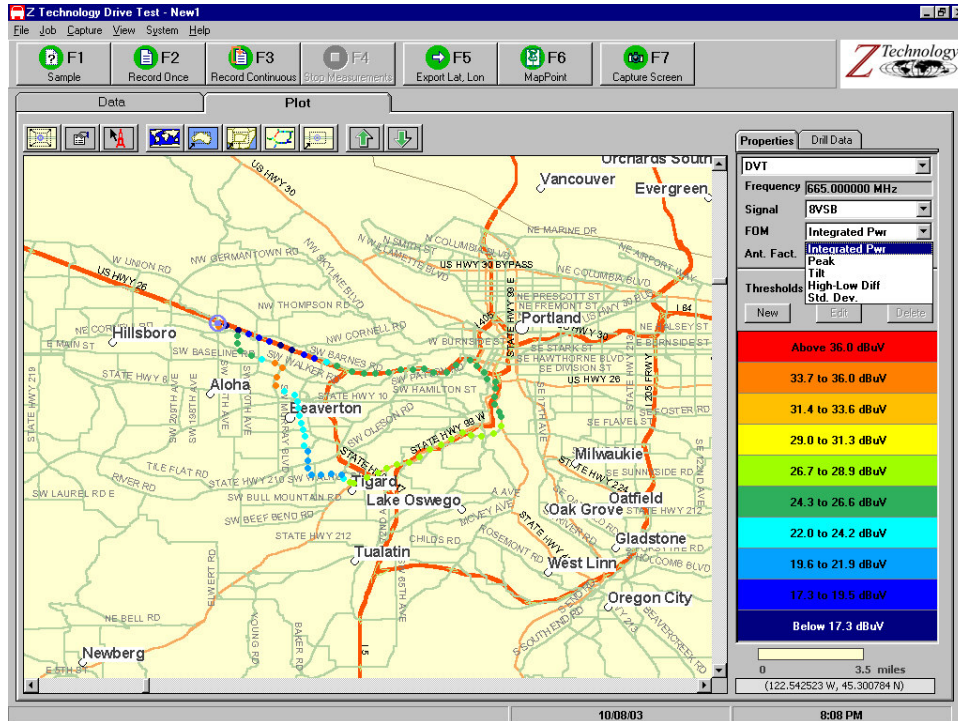
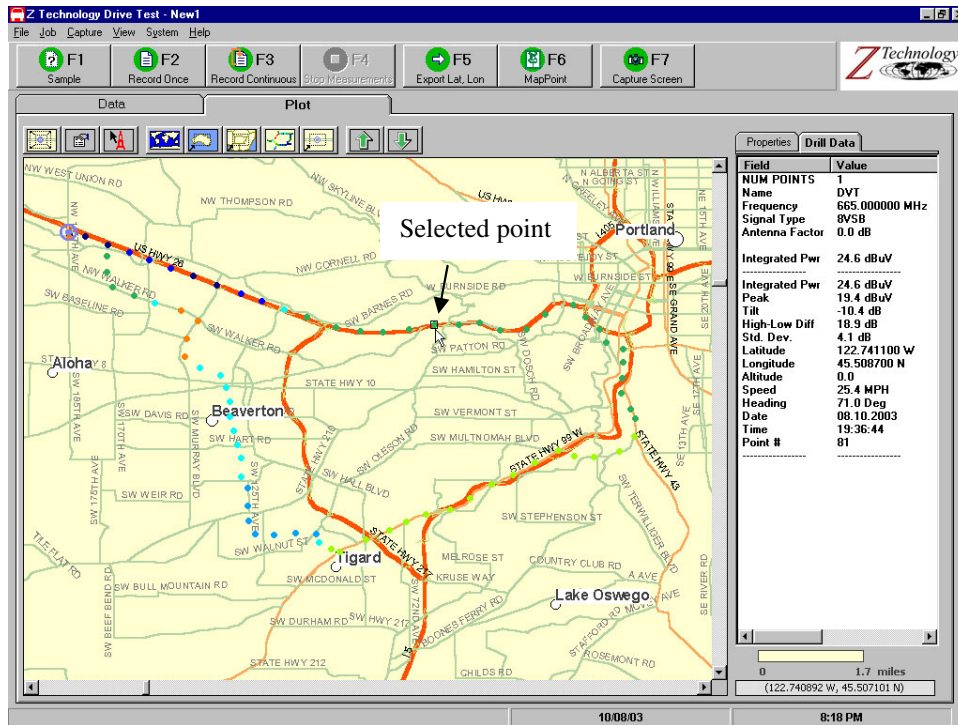


Figure 23: DTV plot

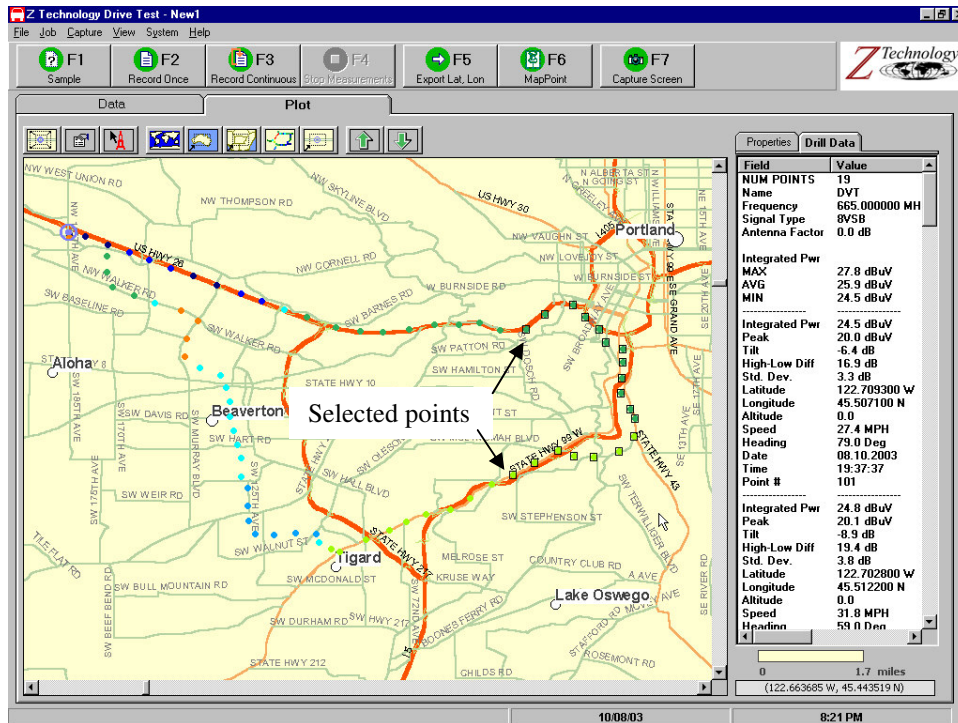
This figure illustrates a Digital Television with Integrated Power plotted. The drop down list titled FOM (Figure Of Merit) shows the parameters that can be plotted.

The list contains the following parameters:

Integrated Power, Peak Power, Tilt, High-Low Difference, Standard Deviation, Tap Energy, Main Tap and SNR (Signal to Noise Ratio), MSE (Mean Square Error), SER (Segment Error Rate), Sync Lock, EQ Lock (Equalizer Lock).

Plot Tab: Drill Data - Single Point**Figure 24: Single point data selection**

By placing the cursor over a data point and right clicking the mouse, the data for that point will be displayed to the right of the map. The selected point is noted by the small square over the selected data point. The point selected for this loop is pointed to by the arrow.

Plot Tab: Drill Data - Multiple Points**Figure 25: Multiple data point selection**

A group of points can be selected by holding the right mouse button down and dragging the cursor around a group of points. The data for each selected point is displayed to the right of the map.

Spectrum Monitor

The Spectrum Monitor is accessed from the View Menu.

When recording data, the Spectrum Monitor operates in Recording Mode and provides limited user interaction capabilities. When not recording, the full compliment of user control is available. The title bar at the top left of the screen alerts the user to the status of the spectrum monitor. The status will either say Live Signals or Recorded Data.

Live	Provides a synchronous update of the spectrum and decoder displays.
Single Sweep	Provides a single synchronous update of the spectrum and decoder displays.
Frequency	Provides selection of frequencies from the current job file. A frequency can also be entered manually. The frequency step low (left arrow) and step hi (right arrow) will change the one screen width.
Modulation	Provides for amplitude correction of spread spectrum signals such as digital television signals. Digital should be selected for spread spectrum signals and Normal for all others.
Amplification	Buttons to allow the user to change the gain of the Field Strength Meter
Sweep Width/IFBW	Provides a selection of sweep widths and IF bandwidths.
Graticule	Provides frequency Markers, Active Cursor and Peak Line for the spectrum display. When Markers or Active Cursor are selected, additional information is displayed to the right of the spectrum. Active Cursor will display frequency and amplitude for the location of the active cursor. Whenever the cursor is inside the spectrum display area on the screen, the cursor becomes a vertical pointer ↑ and will follow mouse movement. Markers display four vertical markers on the spectrum display. The marker frequency spacing can be set using the Marker Widths dialog boxes. The data displayed to the right of the spectrum display is a function of where the markers are placed. Notice the Outer and Inner markers section to the left of the spectrum display. Peak line enables a peak value indicator between the outer markers. This is available in Recording Mode.

Spectrum Monitor, Recording Mode, of an 8VSB Broadcast Signal

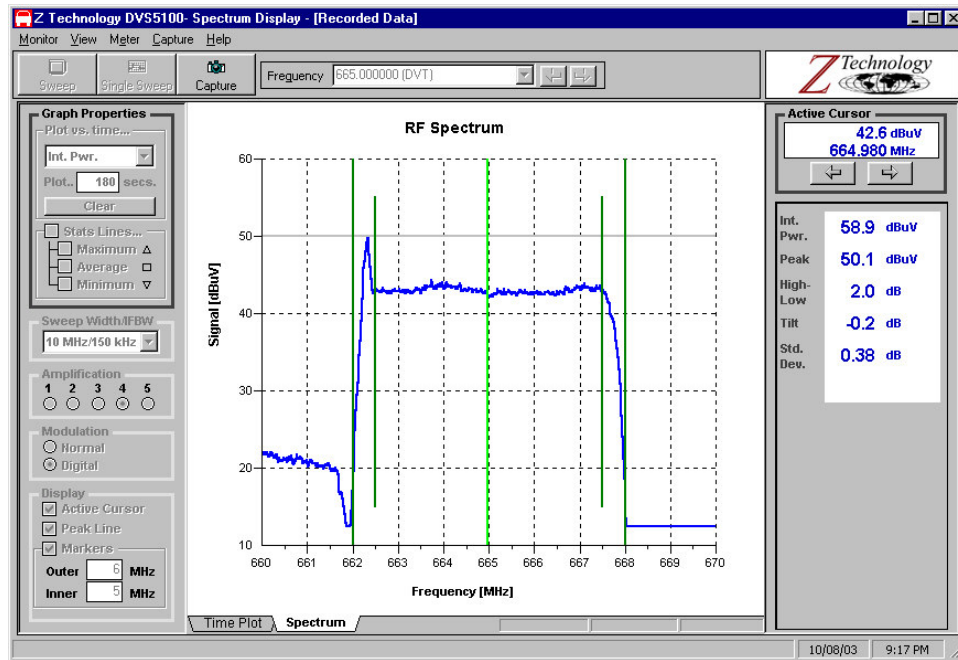


Figure 26: Spectrum Monitor in Recording Mode of 8VSB DTV signal

This is the Spectrum Monitor in Recording Mode displaying an 8VSB Digital television signal at 665 MHz. Note that all the user selectable parameters are grayed out (not available) except for the Peak Line and Screen Capture. Also note the text in the title bar that says Recorded Data.

Spectrum display of FM Broadcast Signals

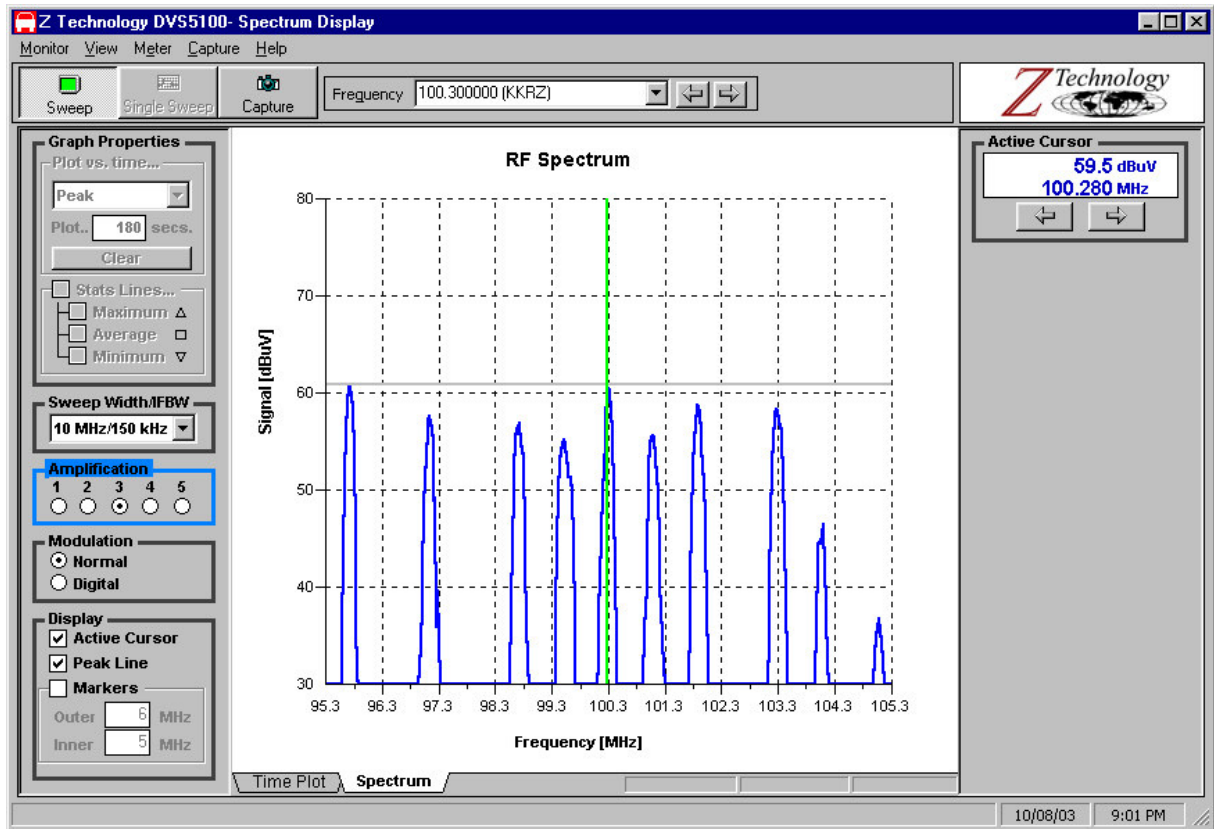


Figure 27: Spectrum of Frequencies centered at 100.3 MHz

Spectrum Display

The Spectrum Display is accessed from the View Menu. When recording data, the Spectrum Display operates in Recording Mode and provides limited user interaction capabilities. When in Recording mode, some of the visible user controls are set by the contents of the JOB, and thus are grayed out. When not recording, the full compliment of user control is available. When in Recording mode, the title bar at the top left of the screen alerts the user by displaying "Spectrum Display [Recording Mode]". When not in recording mode the title bar displays "Spectrum Display".

Top Screen -- Spectrum Analyzer Controls

Sweep	Provides asynchronous update of the spectrum and decoder displays.
Single Sweep	Provides a single synchronous update of the spectrum and decoder displays.
Capture Screen	Screen capture placed in current Job output folder
Frequency	Provides selection of frequencies from the current job file. A frequency can also be entered manually. The frequency step low (left arrow) and step hi (right arrow) will change the one screen width.
Graph Properties	Only active when viewing Time Plots. See Time Plots below.

Sweep Width/IFBW	Provides a selection of sweep widths and IF bandwidths.
Amplification	Buttons to allow the user to change the gain of the Field Strength Meter
Modulation	Provides for amplitude correction of spread spectrum signals such as digital television signals. Digital should be selected for spread spectrum signals and Normal for all others.
Display	Provides frequency Active Cursor, Peak Line, and Markers for the spectrum display. When Markers or Active Cursor are selected, additional information is displayed to the right of the spectrum. Active Cursor will display frequency and amplitude for the location of the active cursor. Whenever the cursor is inside the spectrum display area on the screen, the cursor becomes a vertical pointer ↑ and will follow mouse movement. Markers display four vertical markers on the spectrum display. The marker frequency spacing can be set using the Markers dialog boxes. The data displayed to the right of the spectrum display is a function of where the markers are placed. Notice the Outer and Inner markers section to the left of the spectrum display. Integrated Power and Peak Power are measured between the outer markers, Tilt, High Low Difference, and Standard Deviation are measured between the inner markers. Peak line enables a peak value indicator between the outer markers. This is available in Recording Mode.

Time Plot of Integrated Power

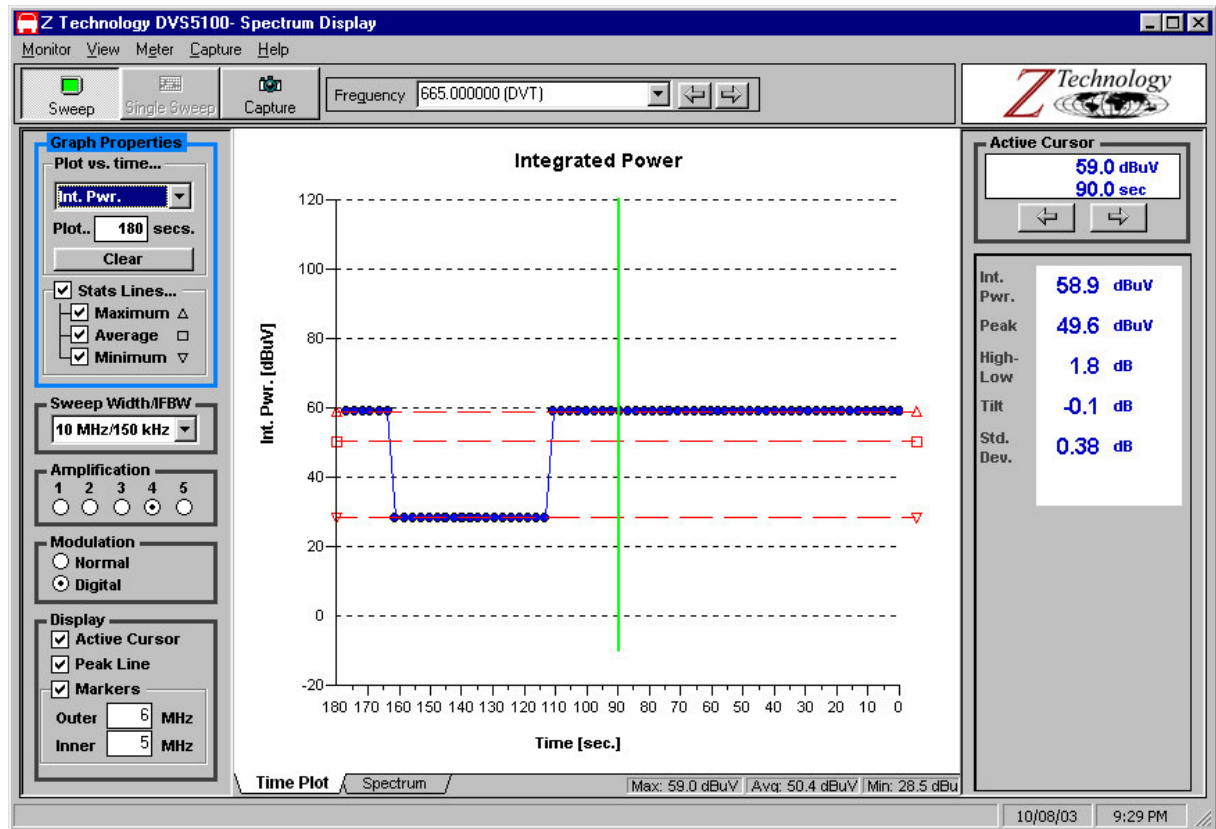


Figure 28: Time Plot of Integrated Power in Recording Mode of DTV signal

This Figure shows the Plot versus time capability. Integrated Power is plotted versus time with the horizontal axis covering 180 seconds. All Figures of merit are available for plotting by selecting them from the **Graph Properties - Plot vs. Time...** pull down menu. For an 8VSB signal type the Figures of Merit available for plotting are Integrated Power, Peak Power, High-Low, Tilt and Standard Deviation.

Section 4: Data Export, MapPoint Import

Using the Lat/Lon Exporter

The Export button (F5) provides allows the user to export collected data in other formats. The user may select the fields at the time of export from a list of available fields. The fields may be exported in any user selected order. The available fields depend on the Signal Type. "Signal", all GPS parameters, and all Figure of Merit parameters are available for Export.

DTEExport was specifically designed to create data files that can be imported into spread sheets, data bases, and CAD or GIS programs. DTEExport includes a special MapPoint format that creates data files compatible for import into Microsoft MapPoint. When the Microsoft MapPoint option is installed, a MapPoint button appears on the DriveTest 2 main tool bar and DTEExport automatically defaults to MapPoint export format.

To display measurement data on the Microsoft MapPoint map, data must first be exported from DriveTest using the MapPoint format, then Imported to MapPoint.

To export data for MapPoint, click the **Export Lat, Lon** button in the DriveTest main toolbar. The first DTEExport screen shows a list of frequencies that may be exported.

Each frequency may be exported separately to a different file, all export files are automatically named and written to the jobs DT_Output folder. The name of the exported file is based on the original job name, the frequency, the frequency name, the signal type, and the export format. The export format codes are "MP" for MapPoint, "Gen" for Generic format. Example:
C:\DT_Output\Factory\Factory, 100.000000,FREQ 1,ANALOG,MP.txt .

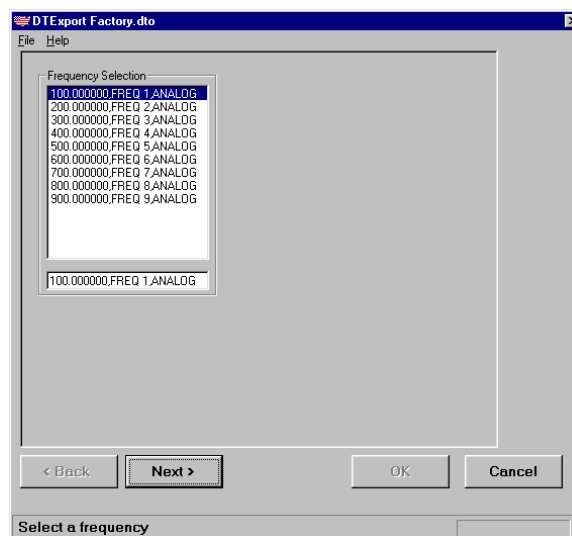


Figure 29: DTEExport – Frequency selection screen

Select a frequency then click the Next button a new screen appears with Latitude, Longitude, and Signal parameters automatically loaded into the right hand Parameters to Export box.

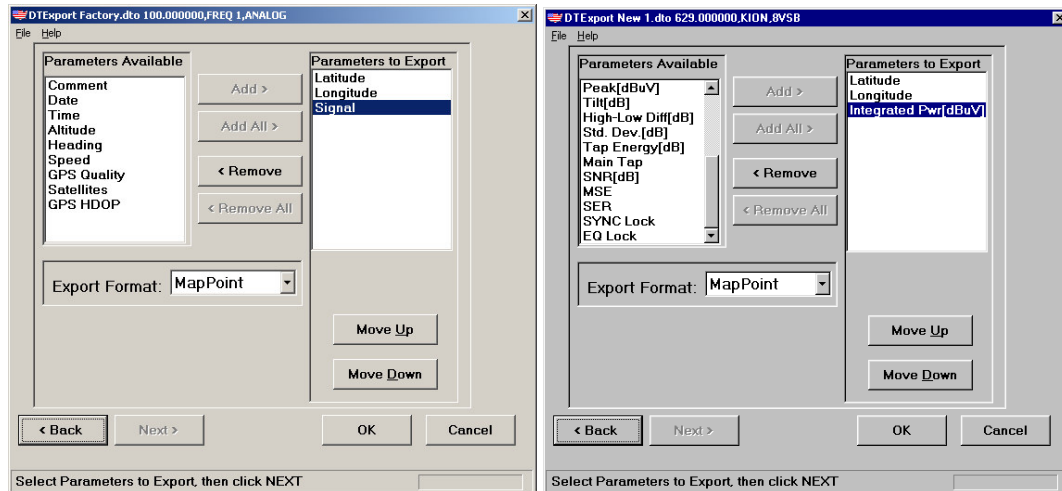


Figure 30: DTExport – Left Screen- Analog Signal Type, Right Screen 8VSB Signal Type parameters to export

Click OK to advance to Complete the Export. If MapPoint is not installed, the Export format defaults to Generic. The Generic format allows the user to export in any number of fields in any order from right hand Parameters Available box to a columnar comma delimited text file with field headings.

Use the Generic export format to create import files for other applications and databases.

A completion bar follows the progress of the export. When complete the user may exit or select another frequency to export.

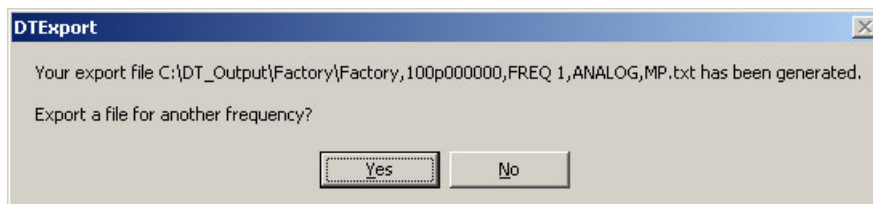


Figure 31: DTExport – Completion, Exit or select another Frequency

Exit by clicking **No**.

The DriveTest 2 screen re-appears.

Click on the **MapPoint** Button.

MapPoint starts up.

Using the Optional MapPoint Post Process Map

Select **Data: Import Data Wizard** from the MapPoint main menu.

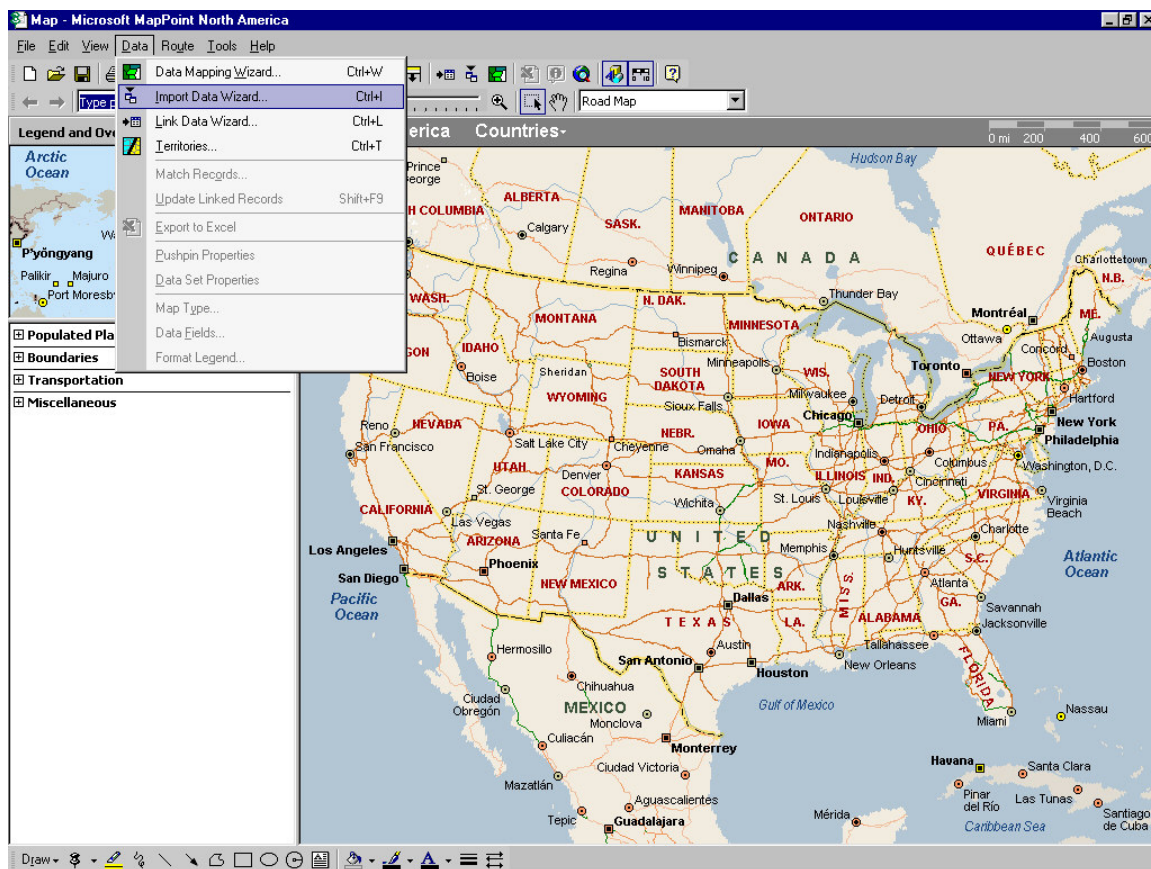


Figure 32: MapPoint – Data: Import Data Wizard Menu item

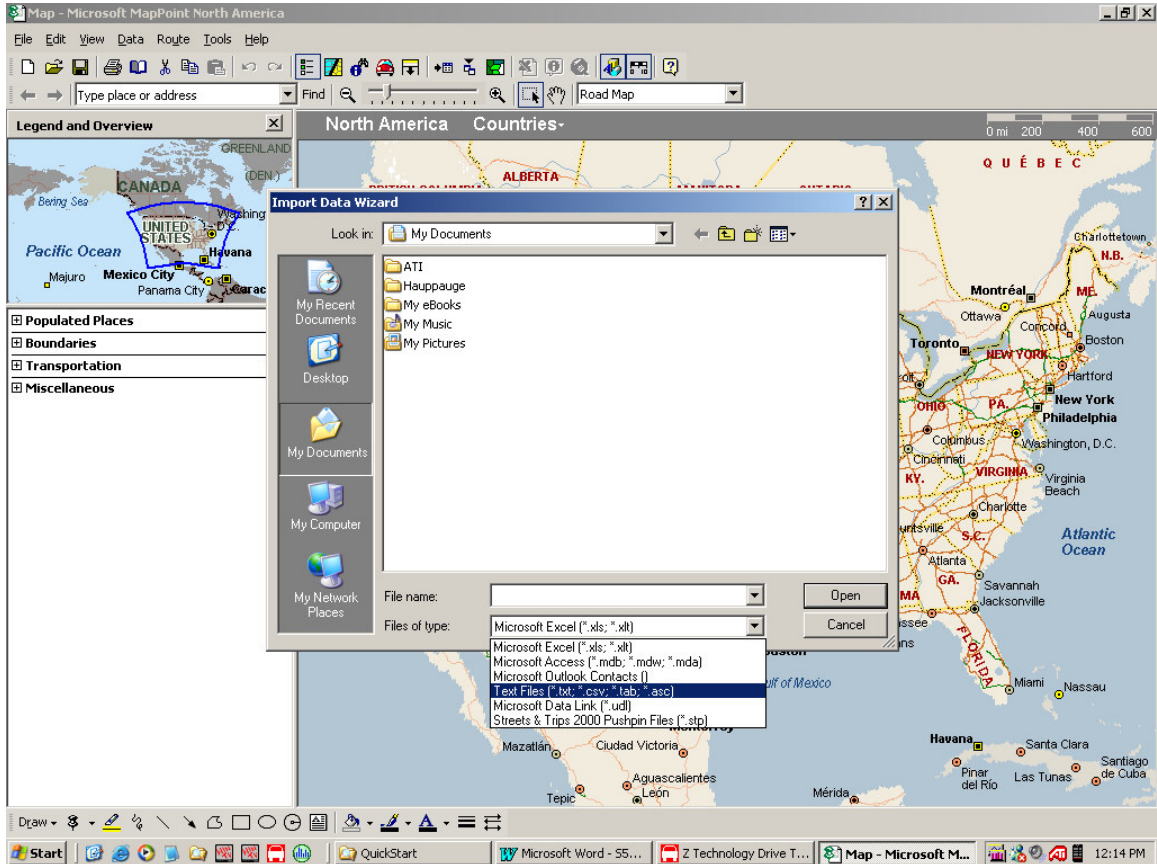


Figure 33: Import Data Wizard - .txt data file type

The MapPoint Data Import Wizard automatically displays a browse window to locate the file to be imported. Set the import file type to (.txt)

Browse to the current Job DT_output folder.

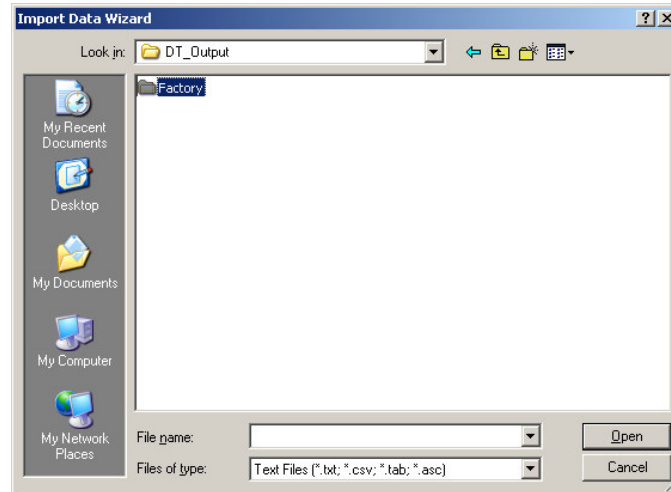


Figure 34: Import Data Wizard – Browsing to the current Job DTOutput folder

Double click on the current DTOutput Folder, in this case **Factory**. A Choose the separator character screen appears.

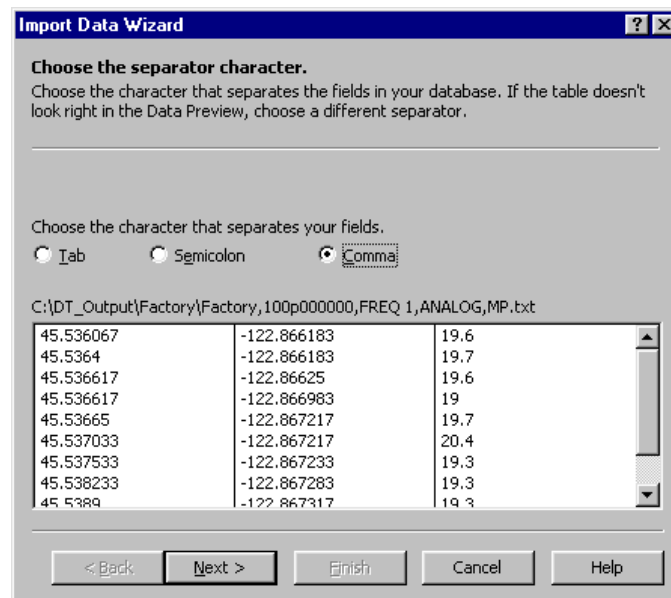


Figure 35: Import Data Wizard - choose separator character

Click the **Comma** button if not already selected, then Click **Next** to continue. Another import screen appears

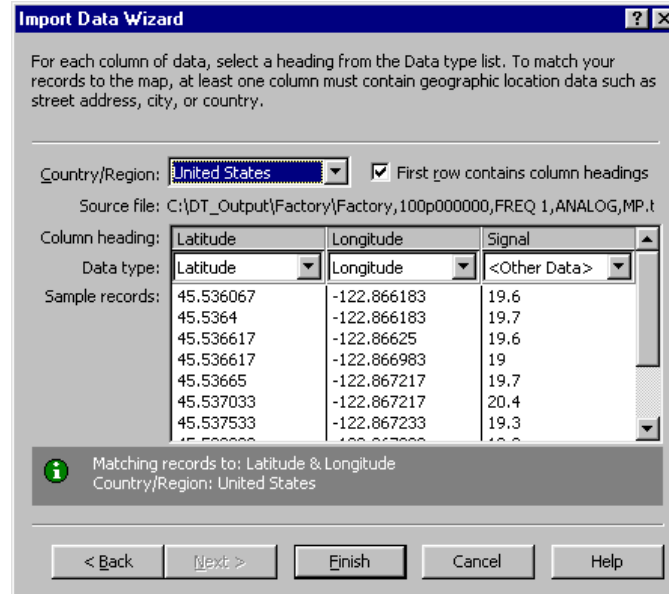


Figure 36: Import Data Wizard - Column Headings

Click **Finish** to complete importing the data. A completion bar indicates the data being imported into MapPoint. After the data has been Imported, a screen appears to query how you would like MapPoint to display the data.

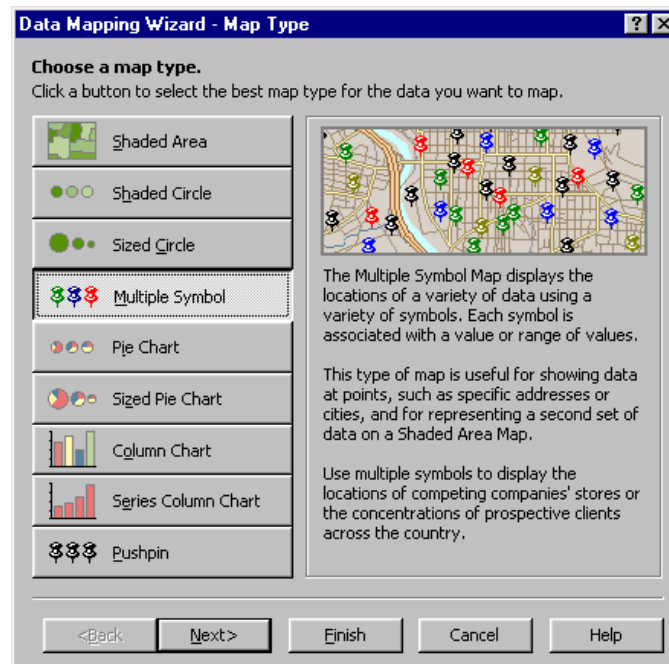


Figure 37: Data Mapping Wizard - Choosing Map Type

Select the Multiple Symbols button, then Click Next. A Data Fields screen appears next to display the fields to be imported.

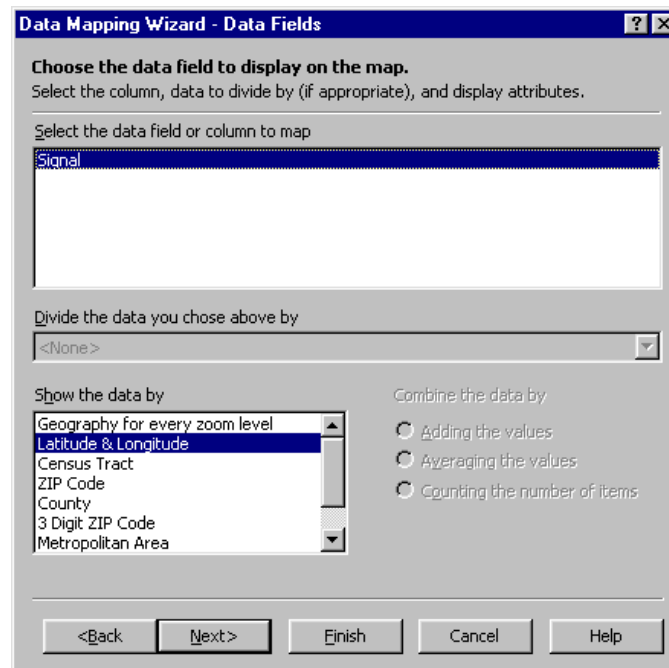


Figure 38: Data Mapping Wizard - Data Fields

Clicks **Next** to continue. A Legend screen appears.

Data Mapping Wizard - Legend

Format the Multiple Symbol Map legend.
Type the legend title, select range formatting, and type corresponding label text.

Legend title:

No. of ranges: Range type: Order: ☒ High to low ☐ Low to high

Symbol:	Data range:	Values mapped:	Range label:
	24 to 27	2	24 to 27
	21 to 23	13	21 to 23
	18 to 20	536	18 to 20
	15 to 17	0	15 to 17
	12 to 14	3	12 to 14

<Back Next> Finish Cancel Help

Figure 39: Data Mapping Wizard - Legend

The Legend screen allows you to change the number of ranges, the colors and how the data is plotted.

Click **Finish** to use the defaults.

Completion bars display as the data is drawn on the map.

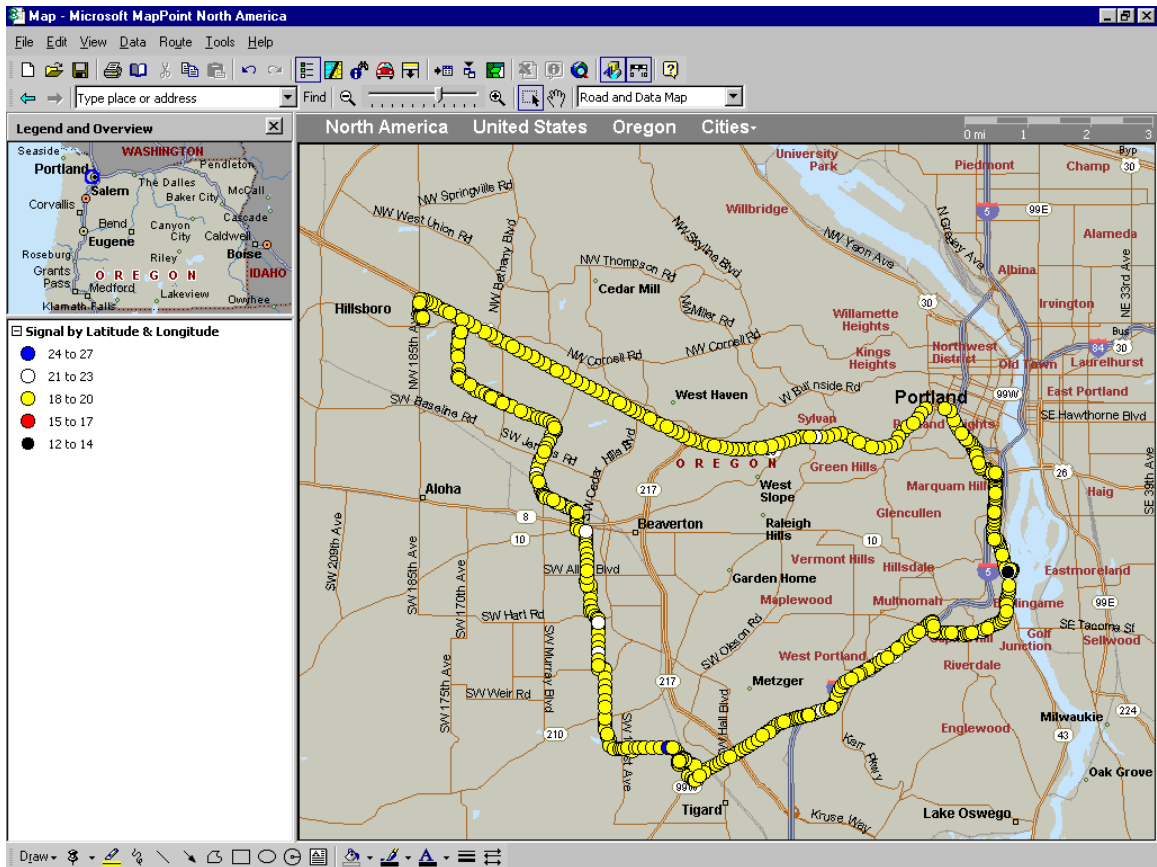


Figure 40: MapPoint displaying Imported Data

The map automatically zooms into the area of the data.

Zoom and Pan on the data, analyze as you wish using the MapPoint user interface.

When done exit the program by selecting **File: Exit** from the main menu. A Save Changes screen appears.

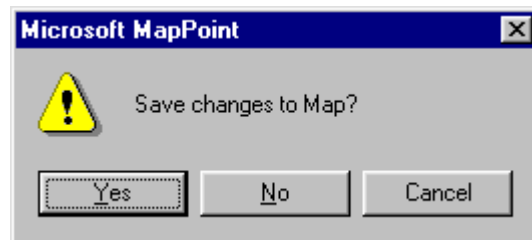


Figure 41: MapPoint – Save Changes?

If you choose **Yes**, a browse window will open to save the file, the next time MapPoint is started it uses the saved file to restore and display the imported data at its last position and zoom setting.

If you choose **No** it will start up its previous position and zoom setting.

Section 5: Maintenance

Introduction

This section will explain how to maintain your system. The system is quite rugged but several items need to be observed.

Before closing the pop-up case:

1. Ensure the CD-ROM drawer is fully closed.
2. Ensure there are no antenna wires or power cables protruding from inside the pop-up case.
3. Place the field strength meter in its transportation position under the PC platform as shown in figure.
4. Lock the PC platform using the quarter-turn fastener in front of the PC.

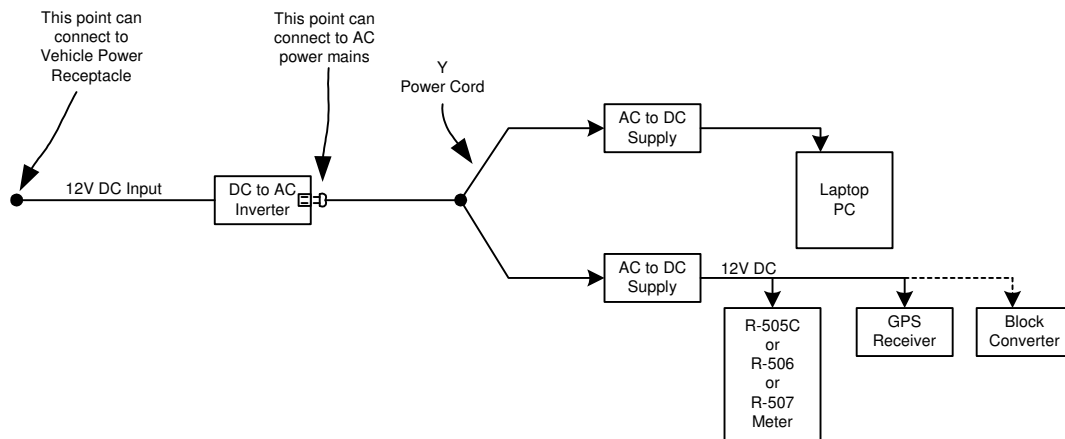


Figure 42: Equipment in transportation position

Wiring Diagram

This systems can be operated from +12V vehicle power or AC power mains voltage. The following diagram explains the power distribution and internal wiring between products inside the carrying case.

S5005C/6/7GPS, S5010STR DVS5100, System power distribution



Directory Structure

The following is the directory structure used to store data on the PC.

```

C:\- |
    |
    |- DT_Input\- |
    |             |
    |             |- Factory.job --> the default job installed from the factory
    |             |- UserJob1.job \
    |             |- UserJob2.job--> )--> Other User created jobs
    |             |- UserJob3.job /
    |
    |- DT_Output\- |
    |              |- Factory\- |
    |              |             |
    |              |             |- DataLayer.dbf
    |              |             |- DataLayer.shp
    |              |             |- DataLayer.shx
    |              |             |- Factory.dto --> (D)rive (T)est (O)utput data file
    |              |             |- Factory.pgm --> Program Log file for diagnostics
    |              |             |- Properties.ini
    |              |             |- Factory(freq1).txt --> translated file for Delorme
    |              |             |- Factory(freq2).txt --> "
    |              |             |- Factory(freq3).txt --> "
    |              |             |- Factory(freq4).txt --> "
    |              |             |- ...
    |              |
    |              |- UserJob1\- |
    |              |             |
    |              |             |- DataLayer.dbf
    |              |             |- DataLayer.shp
    |              |             |- DataLayer.shx
    |              |             |- UserJob1.dto --> (D)rive (T)est (O)utput data file
    |              |             |- UserJob1.pgm --> Program Log file for diagnostics
    |              |             |- Properties.ini
    |              |             |- UserJob1(freq1).txt --> translated file for Delorme
    |              |             |- UserJob1(freq2).txt --> "
    |              |             |- UserJob1(freq3).txt --> "
    |              |             |- ...
    |
    |Mapdata\
    |         |- USA          |- ESRI map data for USA
    |         |- World       |- ESRI map data for (rest of) world
    |- Program Files\
    |               |- Z Technology
    |               |             |- Drive Test 2
    |               |             |- DriveTest 2.exe --> Drive Test executable & supporting files
    |               |             |- DTExport
    |               |             |- DTExport.exe
  
```

To delete a job, use **Delete Job and Data** from the **Job** Menu. The job file named Factory cannot be deleted using the Job menu.

Section 6: Options & Accessories

Options

ITEM	DESCRIPTION
Option MD 01	Adds Real Time North America Map Data
Option MD 02	Adds Real Time European Map Data
Option MA 04	Adds Post Measurement North America Microsoft MapPoint
Option MA 05	Adds Post Measurement Europe Microsoft MapPoint
Option MA 06	Adds Post Measurement Custom Map
Option M	Antenna mounting kit, magnetic

Accessories

ITEM	DESCRIPTION
BC-BCB	Block Converter, 0.3 to 3.0 MHz range
BC-PCS	Block Converter, 1750 to 1980 MHz range
BC-PCS2	Block Converter, 2000 to 2500 MHz range
AA1-B1	Calibrated tuned dipole antenna 30 - 70 MHz
AA1-B2	Calibrated tuned dipole antenna 65 - 180 MHz
AA1-B3	Calibrated tuned dipole antenna 170 - 340 MHz
AA1-B4	Calibrated tuned dipole antenna 325 - 1000 MHz
AA1-SET	Calibrated tuned dipole antenna set 30 - 1000 MHz; includes case, antennas B1, B2, B3, B4
TV-1	Calibrated tuned dipole antenna 57 – 219 MHz
TV-2	Calibrated tuned dipole antenna 325 – 1000 MHz
AA-TV Set	Calibrated tuned dipole antenna set, UHF and VHF TV bands (57 1000MHz), includes case and calibrated cable
AA-2	Active monopole antenna system, battery power, 100 kHz - 60 MHz
AA-3	Biconical antenna system 20 MHz - 330 MHz
AA-4	Log Periodic antenna system 290 MHz - 1000 MHz
AA-6	Log Periodic antenna system 150 MHz - 1000 MHz

AA-7	Bi-Log Periodic antenna system 25 MHz - 1000 MHz
AA-8	Log Periodic antenna system 800 MHz - 2600 MHz
CAB58xN	Calibrated Cable X meter RG58U, N connectors (X=length in meters)
CAB214xN	Calibrated Cable X meter RG214U, N connectors (X=length in meters)

Section 7: Appendix A

Field Strength Meter Remote operation

Problem: “1 Port” Does not appear on the meter Display.

1. Make sure power +12V is applied to the rear panel Power Input connector.
2. Press the Red POWER button on the front panel of the Field Strength Meter.
3. Press the function button once. “F1” will appear.
4. Rotate the Tune Knob counter clockwise until “F93” appears.
5. Press the Tune Knob. “1 Port” will appear on the front panel display.

GPS Trouble Shooting

1. Ensure the GPS antenna is plugged into the GPS receiver.
2. A new system requires the GPS receiver to download data from satellites. This may take up to 20 minutes.
3. A minimum of three satellites is required for Longitude and Latitude data.
4. The GPS antenna must be located so that adequate satellite reception is possible. Inside buildings or tunnels will often result in lost satellite reception.

Drive Test Data Format

The data file created by Drive Test is stored in a folder by the same name as the name of the job. The data file is named the same as the job with a .dto extension.

Please see Section 4: Maintenance for Drive Test directory structure.

Example: A job is created and named test1. This action creates a folder named test1. In the test1 folder will be a file named test1.dto. This file will be created after data has been collected by selecting the **Record Once** or **Record Continuous** buttons on Drive Test.

The total number of fields vary with Signal Type. The first 19 fields are present in every record. If a non-Analog Signal Type is selected, five RF Figure Of Merit fields are added. If an 8VSB Signal Type is selected, an additional six fields are added. Header information is also stored in the .dto file prior to any data being collected. The header information consists of meter settings and many of the parameters used to define the specific job. Each time a job is restarted, header information is added. A sample .dto file follows the field definitions.

Field Definitions:

Field Name	Description
Date	PC Date of measurement
Time	PC time of measurement
Freq	Frequency measured
FreqUnits	Units of frequency, only MHz supported at this time
Signal	Signal Strength measured
SignalUnits	units of measurement, can be dBuV, dBm, or dBuV/M
Lat	Latitude of measurement in decimal degrees format, WGS-84 datum
Lon	Longitude of measurement in decimal degrees format, WGS-84 datum
FreqName	Name of frequency assigned by user
AntFactor	Antenna factor for measured frequency assigned by user
Altitude	Altitude of measurement
AltitudeUnits	Units of Altitude, can be Feet, or Meters
Heading	Heading or direction of movement of measurement vehicle
HeadingUnits	Units of heading, degrees 0 - 359 true (not magnetic)
Speed	Speed of measurement vehicle
SpeedUnits	Units of speed can be MPH (miles per hour), Knots, or KmH (Kilometers per hour)
Quality	GPS fix quality, 0 = no fix, 1 = standard fix, 2 = differential corrected fix
Satellites	Number of GPS satellites being received
HDOP	Horizontal Dilution of Position, a measure of the geometry of satellites being used to generate fix
<i>Each of the above fields is always present</i>	
<i>The next group is present if not an Analog Signal Type</i>	
Integrated PWR	RF energy of swept signal within outer markers
Peak	RF Peak of swept signal within outer markers
Tilt	Tilt of Swept Signal between inner markers
High-Low Diff	High-Low Difference of swept signal between inner markers
Std. Dev.	Standard Deviation of measurement points within inner markers of swept signal

Sample .dto file

```
' JobName=Factory.dto
' JobFileVersion=1.02
' Locked=No
' IncludeComment=Yes
' FullDataRecords=Yes
' SignalUnits=dBuV
' SpaceUnits=English
' RFAmp=Off
' Bandwidth=WB
' DelayDimension=Time
' Delay=1
' FreqListLength=10
' Freq 1= 100,Freq_1, 0,
' Freq 2= 200,Freq_2, 0,
' Comment=Start of drive test at Z Technology parking lot.
9/11/00,1:38:58 PM,100.000000,MHz,23.9,dBuV,45.536000,-122.866383,Freq_1,0.0,,,000,Deg,0.000000,,1,3,001.7,
9/11/00,1:38:59 PM,200.000000,MHz,15.6,dBuV,45.536000,-122.866383,Freq_2,0.0,,,000,Deg,0.000000,,1,3,001.7,
' JobName=Factory.dto
' JobFileVersion=1.02
' Locked=No
' IncludeComment=Yes
' FullDataRecords=Yes
' SignalUnits=dBuV
' SpaceUnits=English
' RFAmp=Off
' Bandwidth=WB
' DelayDimension=Time
' Delay=1
' FreqListLength=10
' Freq 1= 100,Freq_1, 0,
' Freq 2= 200,Freq_2, 0,
' Comment=Paused for lunch. Starting again to finish drive test.
9/11/00,1:40:47 PM,100.000000,MHz,23.5,dBuV,45.538150,-122.867283,Freq_1,0.0,-
78.7,,358,Deg,24.782609,,1,6,001.4,
9/11/00,1:40:47 PM,200.000000,MHz,15.3,dBuV,45.538233,-122.867283,Freq_2,0.0,-
78.7,,358,Deg,25.031056,,1,6,001.4,
```

NOTE: This recording started on 9/11/00 at 1:38:58 PM then was either stopped or paused. The recording started again at 1:40:47 PM on the same day. Notice the two comments.

Section 8: Appendix B

Installing Third Party ESRI Map Data

General Description

The Z Technology DriveTest system is capable of displaying RF Measurement data overlaid on digital map data from 3rd party suppliers. The digital map data is required to be in ESRI Shape file format. Each shape file creates a data layer. The data layers overlay one another to create the digital map. DriveTest expects a specific type of data in the Shape files. Shape files must have specific file names, be located in specific folders, and be no larger than about 30 Megabytes to keep system performance acceptable. The digital map data should be broken up into regions where the data of each region is 30 Megabytes or less. DriveTest will only load the regions it needs to supply a background to the RF Measurement data.

This document introduces digital mapping, list contacts for 3rd party digital map data vendors. It describes the requirements of the digital map data for the DriveTest system, and provides instructions on file naming and file placement on a DriveTest system.

DriveTest incorporates a mapping tool that both generates ESRI Shape files containing RF Measurement data and reads digital map data in ESRI Shape file format to overlay the measurement data on. Digital map data is available for all parts of the world in this format. DriveTest comes from the factory equipped with World Map Data that includes Country outlines, and in the case of North America includes Highways and Major roads.

For a technical description of ESRI Shape file format go to:

<http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf>

Digital Map Data Sources

ESRI (Environmental Systems Research Institute, Inc.) provides software products Such as Arc View© , and Arc Info© that can both read and write Shape files as well as many other formats. Additionally Products from MapInfo© also have translators that can produce Shape file format. These products can also read the RF Measurement shape files produced by the DriveTest System.

To find providers of digital map data for your area in ESRI Shape file format contact your local ESRI dealer. They may be able to put you directly in contact with a digital map data provider that is capable of providing data that meets the DriveTest system digital map data requirements. They may be able to provide the data themselves. Find an ESRI dealer in your area at:

<http://www.esri.com/company/contactusa.html> in the USA, or

<http://gis.esri.com/intldist/contactint.cfm> outside the USA.

Alternatively go to:

<http://www.geographynetwork.com> - this is a consortium of data providers who use ESRI format.

Here you will find many different types of digital map data. In this Consortium, "Transportation Networks" is a category of data most useful to use as background maps for DriveTest.

DriveTest Digital Map

The Map displayed in DriveTest is made up of many layers of different types. Some layers are able to display Polygons, some display Lines, some display Points. Each layer contains only one type of data. Figure 43 below shows an expanded view of a typical DriveTest map.

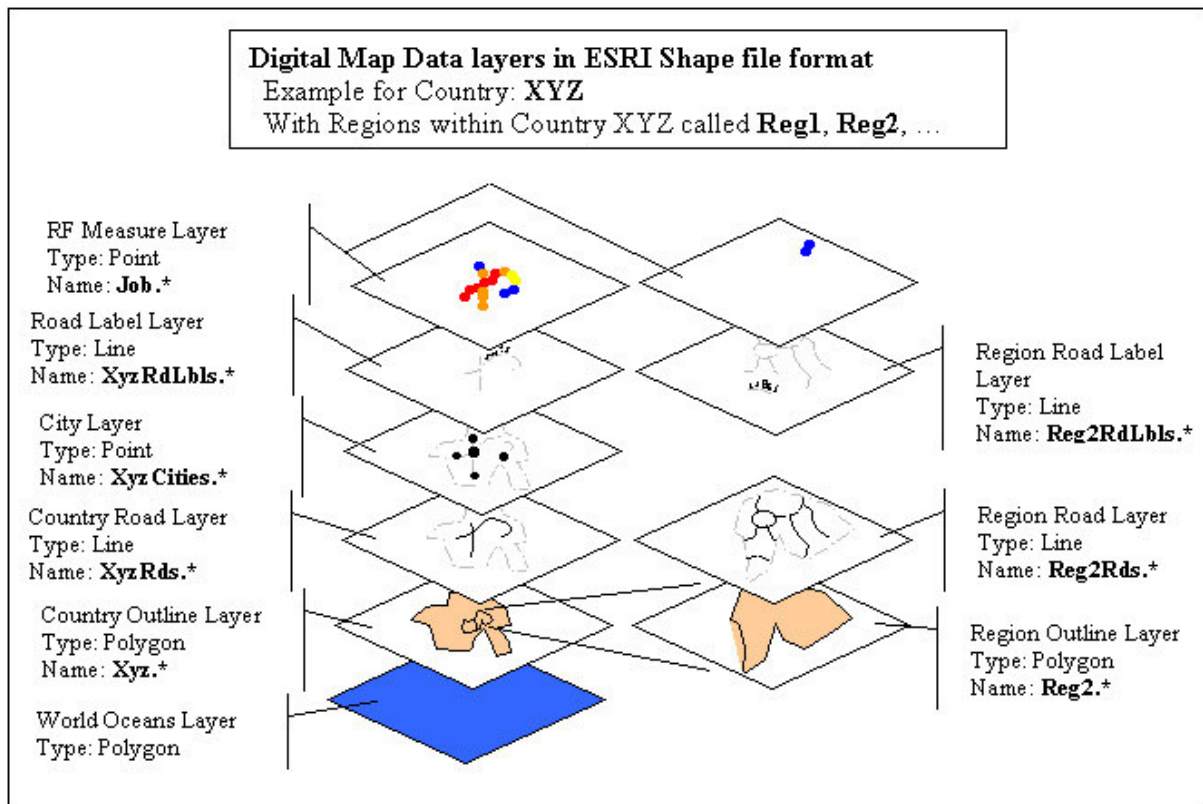


Figure 43: Digital Map Data Layers

The gray in the illustration is not contained in the shape file; it is there simply for reference to other layers.

At the bottom left is a blue Polygon layer that depicts the world oceans. Above the Ocean Layer are the countries.

Each Country contains:

- A Country Outline Layer
- A Country Road Layer
- A Country City Layer
- A Country Road Label Layer

The Country Outline layer, it is a polygon that depicts the outline of the country. Inside the Country Outline two regions are shown. We will call them “Reg1” and “Reg2”. Reg2 expanded to the right to show further detail.

Above the Country Outline layer is the Country Road layer it contains lines depicting the major roads of the country.

Above the Country Road layer is the Cities layer. It contains points depicting the major cities of the country

Above the Cities layer is the Road Label layer. It contains lines that spell out Road Labels in stroke characters as lines. It is only displayed at suitable zoom levels to minimize clutter.

Above the Road Labels Layer is the RF Measurement Layer. DriveTest has collected this data while making measurements with valid GPS coordinates.

When Regions are installed, and GPS coordinates within a region are found, the Layers for that region are loaded over the Country Road Layer, over the Country Road, and over the Country Road Label Layers.

Each Region contains:

- A Region Outline Layer
- A Region Road Layer
- A Region Road Label layer

The Region outline layer is a polygon of depicting the outline of that region

Above the Region outline layer is a Region Road Layer containing lines that depict the roads in the region.

Above the Region Road layer is a Region Road Label Layer containing lines that spell out the road labels for the roads in that region.

Above all layers is the RF Measurement layer.

Requirements for Digital Map Data

GENERAL	Description
ESRI Shape file format:	ESRI Shape file format is actually data layers. Each layer is made up of three files. IE an ESRI Shape file is actually made up of 4 files, they are: Layer.dbf Layer.prj Layer.shx Layer.shp A reference to “ Layer.* ” includes all four files.
Coordinate System:	Data may be in Latitude/Longitude coordinates or Mercator Meter coordinates. DriveTest uses Latitude/Longitude coordinates as its default coordinate system. If Map Data is in Latitude/Longitude coordinates, less translation occurs within DriveTest resulting in better performance.

	Example: Location of Moscow in Latitude/Longitude coordinates is 37 36' 30", 55 45' 01 Location of Moscow in Mercator Meter coordinates is 412468.41, 6179073.07 The contents of the Layer.prj file define the Coordinate System of the data. Note: If map data is in Latitude/Longitude coordinates and uses WGS84 datum, the Layer.prj file may be omitted. If map data is in Mercator Meter coordinates or uses other than the WGS84 datum, the Layer.prj file is required to allow DriveTest to translate the map data.
Datum:	DriveTest uses WGS84 datum by default. Other Datums may be specified via the Layer.prj file. DriveTest recognizes The contents of the Layer.prj file define the Datum of the data. Note: If map data is in Latitude/Longitude coordinates and uses WGS84 datum the Layer.prj file may be omitted.
Maximum File Size: any one Shape file "a Layer.*"	Maximum File size for any shape file depends on the Target PC. ~ 10 Megabytes → For a 600 MHz PC with 32 Megabytes of RAM ~ 30 Megabytes → For a 1 GHz PC with 128 Megabytes of RAM
Scale:	1:1,000,000 to 1:500,000 are a good scales for Major roads on the Country Level. Anything smaller than 1:500,000 generally cause shape files to become larger than the maximum file size above which impacts performance. 1:4,000 scale data is a minimum scale and requires the data for the country to be broken down into many, possibly hundreds of regions.

At the Country level, the 3rd party map vendor may supply 3 layers, they must use the required filenames as shown below. The Roads included in the Country Level Digital Maps should be only Major City connector Highways, and Expressways. These are roads that show when the map is zoomed out to show the entire country.

Country Level Digital Map Layers to be supplied by 3rd Party Vender:

Naming Convention

Country Level files are placed in a Country folder. The name of the Country folder is the International ISO three digit country name. For Example "Thd" and "Twn" are the ISO three digit country names for Thailand, and Taiwan respectively. Each country level file in the Country folder uses the ISO three digit name as the filename prefix. Below is an example for country "Xyz"

Layer file name	Layer type	Description
Xyz.*	Polygon	Outline of country
XyzRds.*	Line	Major city connector roads for entire country
XyzRdLbls.*	Line	Road Labels spelled out in stroke characters in lines. This allows the use of script characters without the need to load character sets. Some installations use this layer

		for Railroads instead of Road Labels
--	--	--------------------------------------

At the Region level, the 3rd party map vendor may supply 3 layers, they must use the required file names as shown below. These are likely to be the major roads in populated areas, not including details such as alleys. It may include elevated ways, tunnels, subways, sky trains etc.

Region Level Digital Map Layers to be supplied by 3rd Party Vendor :

(Optional depending on file sizes. Use this option if Country layers file sizes are too large)

Region Naming Convention

Region files are placed in a folder. Each Region folder is place in the Country folder. The name of each region folder is the name of the Region. The name can be anything. It can be a numerical sequence such as Reg1, Reg2, Reg3, etc. It may be a unique political or geographic name such as North, South, East, West, Nwest, Neast, etc. Each Region level file uses its Region name as the prefix of its filename. The example below is for a Region folder named "Reg2".

Layer filename	Layer type	Description
RegX.*	Polygon	Outline of a Region named RegX
RegXRds.*	Line	Roads for the Region named RegX
RegXRdLbIs	Line	Road Labels for the Region named RegX spelled out in stroke characters in lines. This allows the use of script characters without the need to load character sets. Some installations use this layer for Railroads instead of Road Labels

Data Location

Map data is located in the C:\Mapdata\World\Xyx folder of the PC hard drive. Where Xyx is the ISO 3 digit name for the country.

Example of location of map data files for Country XYZ that contains Regions named "Reg1", "Reg2", "Reg3", "Reg4", etc. "Reg1" and "Reg2" are shown expanded listing the Reg1 and Reg2 filenames. All regions are similar in structure.

C:\mapdata\world\xyz\

```
xyz.dbf \
xyz.prj  > supplied by Z Technology, Replaced by Vendor
xyz.shp /
xyz.shx /
xyzRds.dbf \
xyzRds.prj  > supplied by Map Vendor
xyzRds.shp /
xyzRds.shx /
xyzCities.dbf \
xyzCities.prj  > supplied by Z Technology
xyzCities.shp /
xyzCities.shx /
xyzRdLbIs.dbf \
xyzRdLbIs.prj  > supplied by Map Vendor
xyzRdLbIs.shp /
xyzRdLbIs.shx /
```

Reg1\

```
Reg1.dbf \
Reg1.prj  > supplied by Map Vendor
Reg1.shp /
Reg1.shx /
Reg1Rds.dbf \
Reg1Rds.prj  > supplied by Map Vendor
Reg1Rds.shp /
Reg1Rds.shx /
Reg1RdLbIs.dbf \
Reg1RdLbIs.prj  > supplied by Map Vendor
Reg1RdLbIs.shp /
Reg1RdLbIs.shx /
```

Reg2\

```
Reg2.dbf \
Reg2.prj  > supplied by Map Vendor
Reg2.shp /
Reg2.shx /
Reg2Rds.dbf \
Reg2Rds.prj  > supplied by Map Vendor
Reg2Rds.shp /
Reg2Rds.shx /
Reg2RdLbIs.dbf \
Reg2RdLbIs.prj  > supplied by Map Vendor
Reg2RdLbIs.shp /
Reg2RdLbIs.shx /
```

Reg3\

Reg4\
.
.
.

Below is an example of an explorer window showing 3rd party Map data for Thailand. The Data vendor has divided the digital map data for the country into 18 regions. The boundaries chosen for regions in this case were political boundaries.

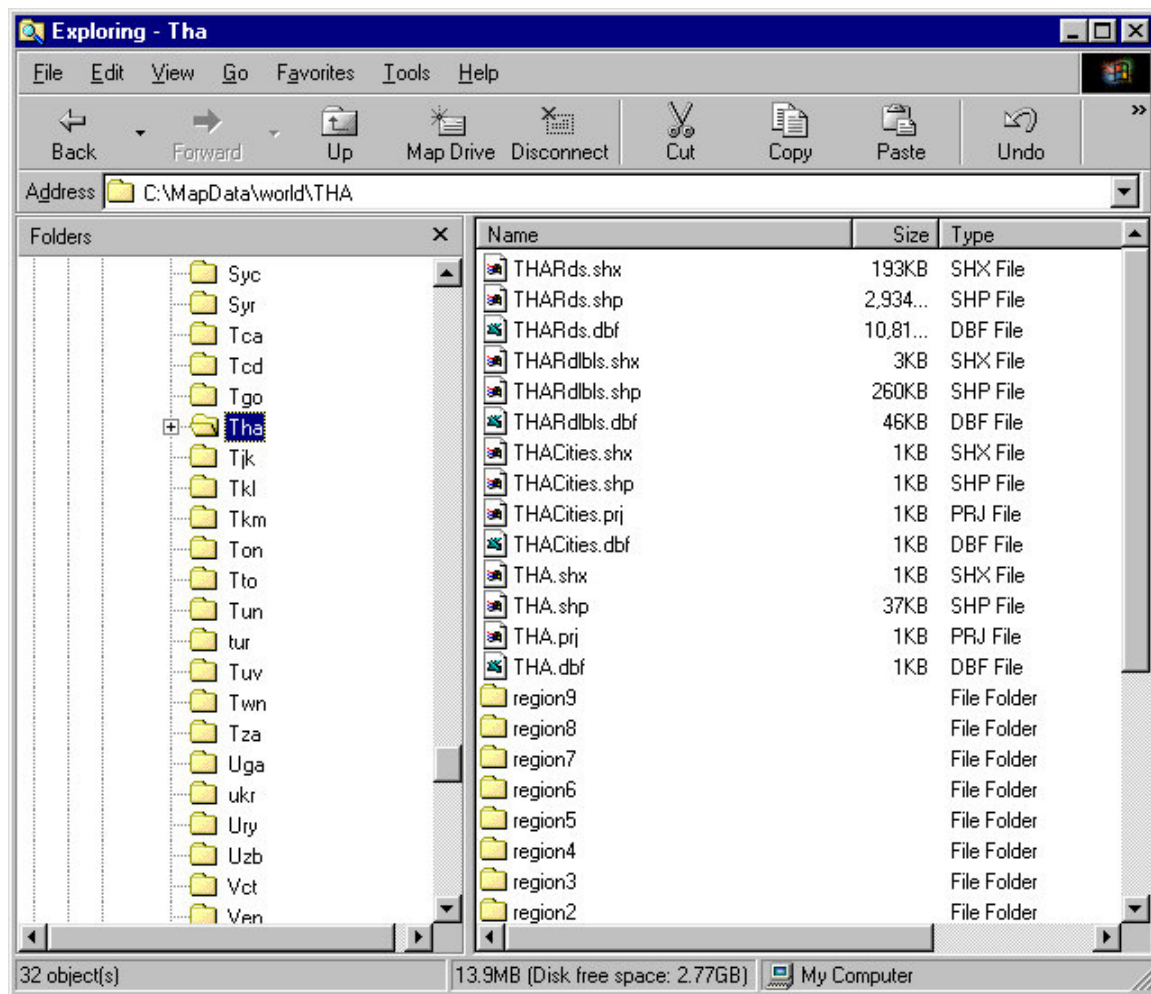


Figure 44: Explorer view of 3rd Party Map Data

Below shows an Explorer view of Thailand Region9 exploded

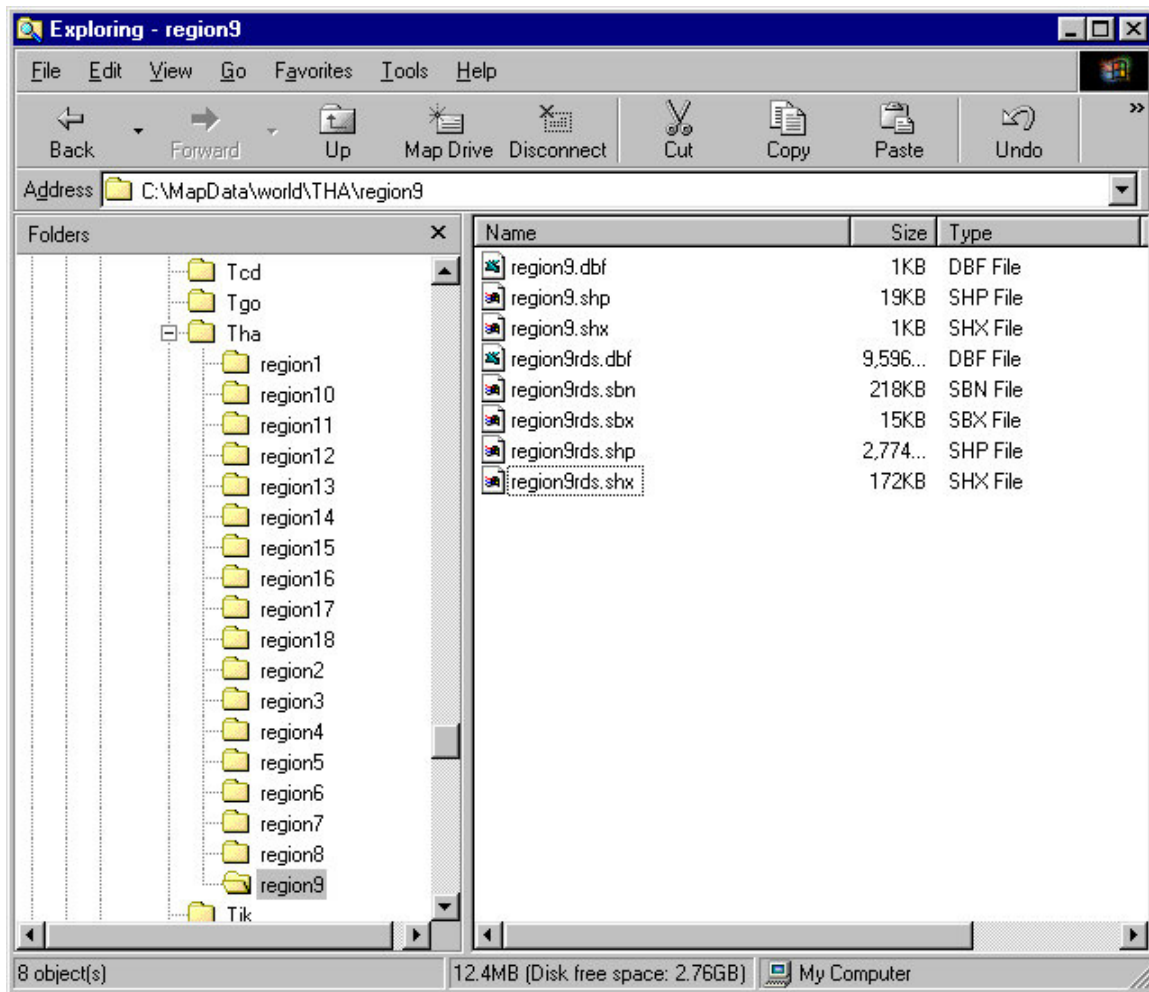


Figure 45: Explorer view of Region9 sub-folder

Below is DriveTest map of the Bangkok area of Thailand showing the major City connector roads, Highways, Expressways. These are the road shown at the Country level in the Country Road folder.

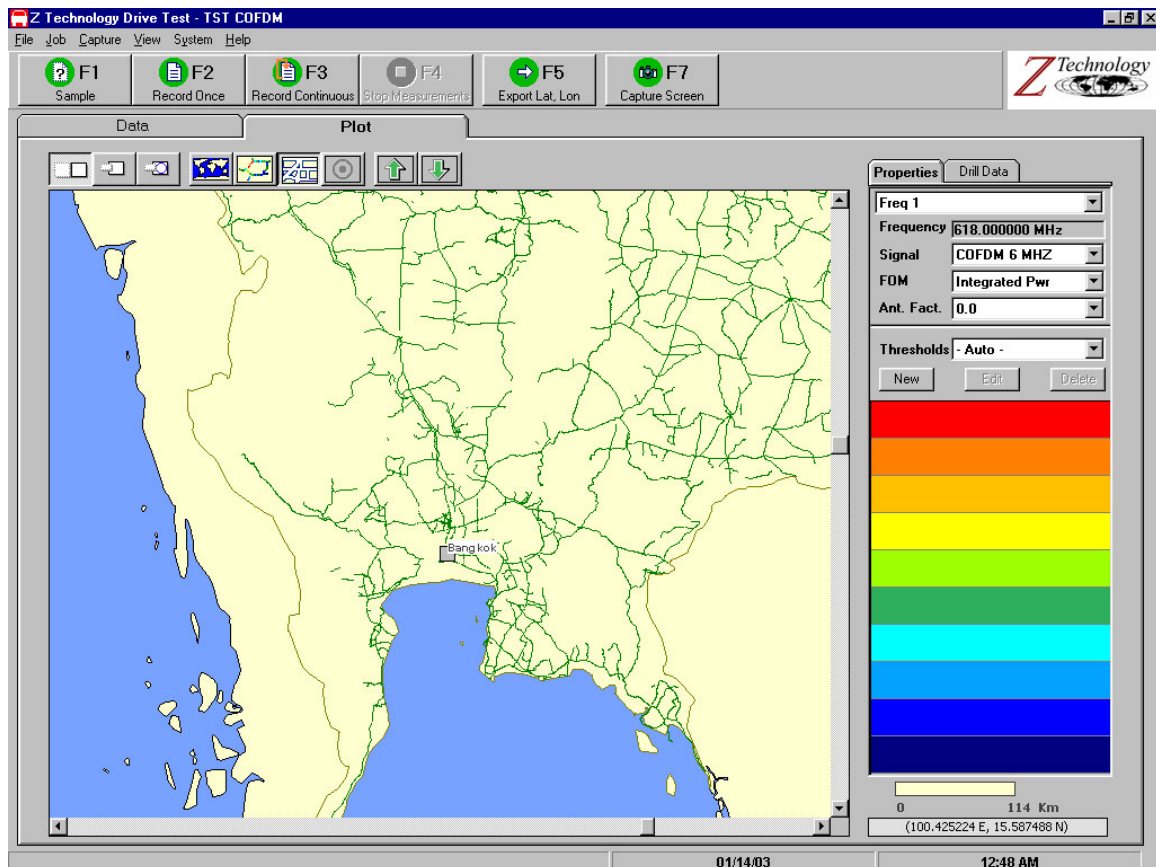


Figure 46: DriveTest map Zoomed out to Country level

Below is DriveTest map of the Bangkok area of Thailand showing the roads at the Region Level in more than one region. The scale of the data, or the data density for different regions can be different as shown here.

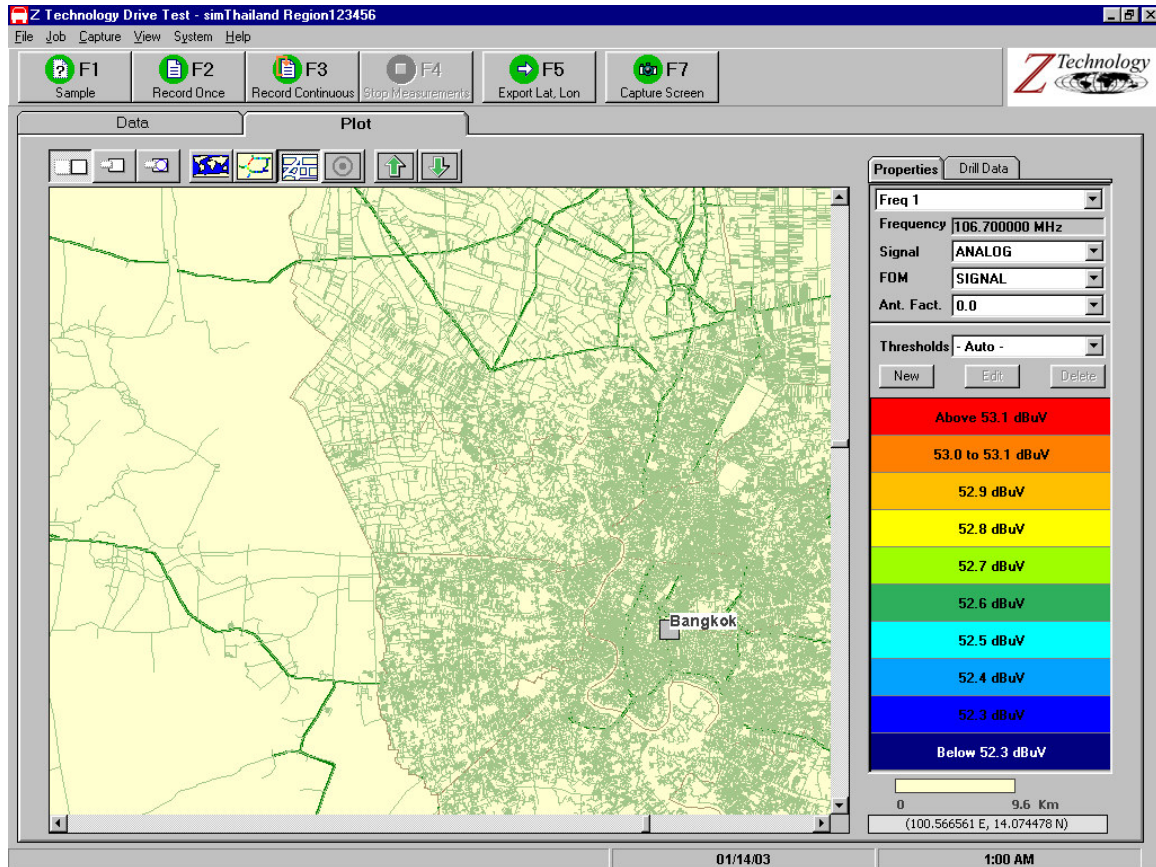


Figure 47: DriveTest Map Zoomed in to Region Level

Below is a Zoomed in DriveTest map of the Bangkok area of Thailand showing the roads at the Region Level.

The orange lines are railways. Railroad data was loaded into the Region Road Label Layer.

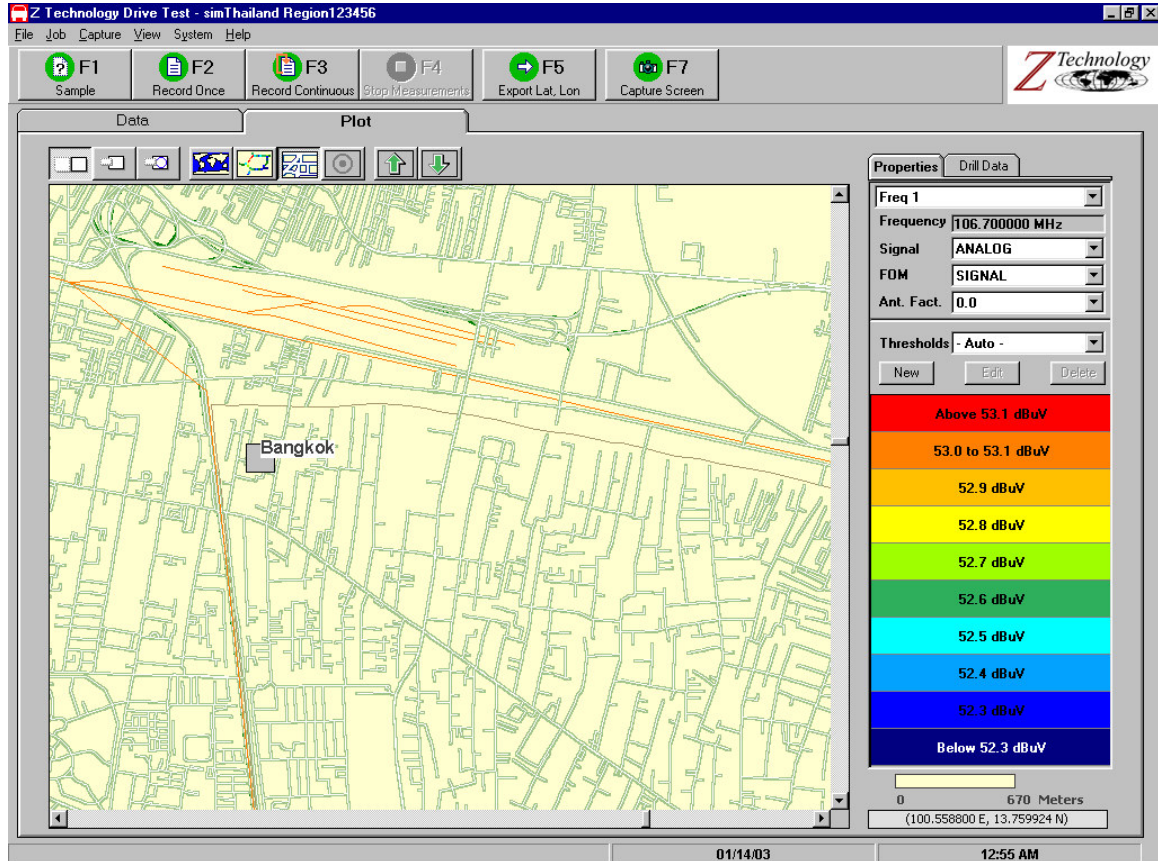


Figure 48: DriveTest Map showing RoadLbls Layer used for Rail Roads

Below is a Zoomed in DriveTest map of the Taipei Taiwan area at a Region Level.

In this case, the Road Label layer contains the stroke characters of the road names saved as lines.

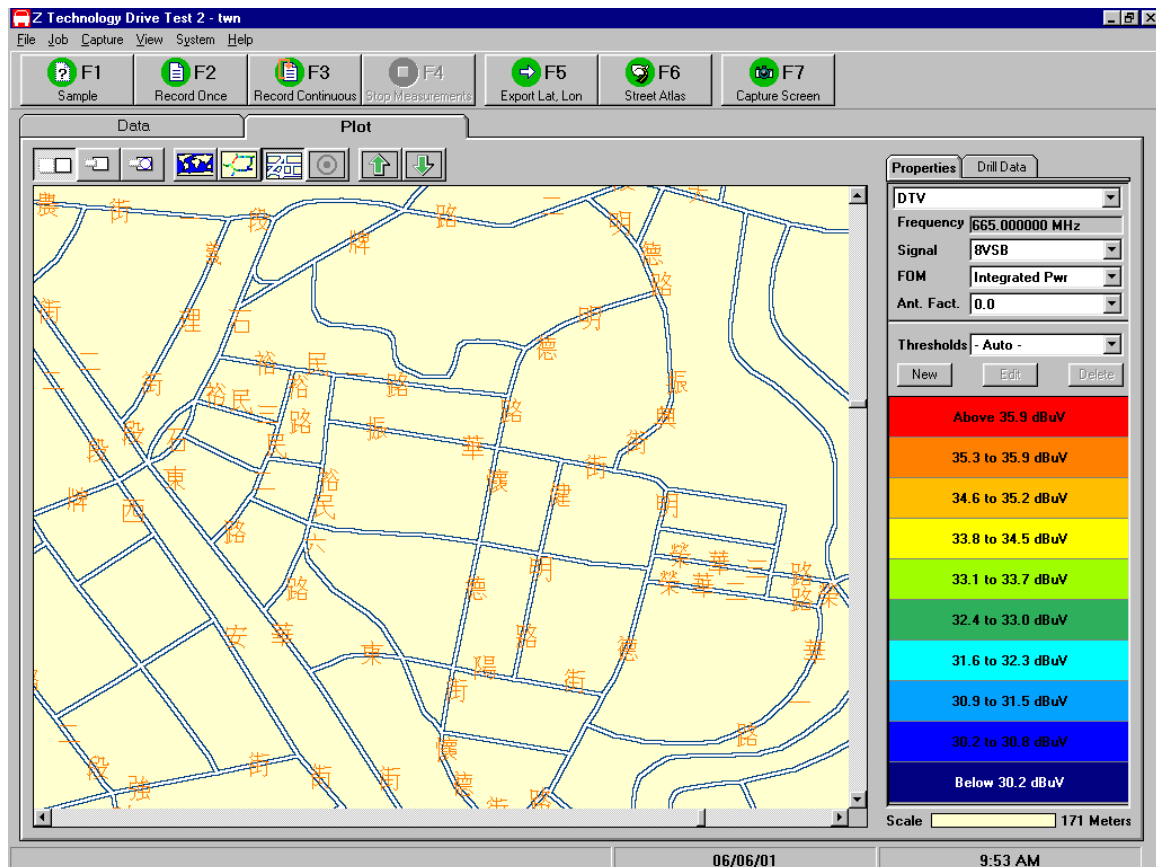


Figure 49: DriveTest Map showing RoadLbIs Layer used to display stroke characters

Data Installation

Third party data is located in C:\mapdata\world\xyz folder where xyz is the three letter abbreviation for that country. Locate the folder with the three letter abbreviation for your country.

If the folder does not exist then start up the DriveTest Application with the GPS connected, place the GPS antenna at a location with a clear view of the sky. When the GPS gets three satellites a GPS fix will be displayed by the DriveTest application. The application will automatically locate the country of the GPS fix and create a country folder with a three letter abbreviation of the country in the C:\mapdata\world folder.

MapData Verification

Once map data is installed, check proper operation by running the DriveTest program.

If the unit is located where the mapdata is then with the GPS connected, verify that the GPS is generating GPS fix data, then click the DriveTest Plot Tab. This will plot the current location showing the newly installed maps.

If the unit is not located where the mapdata is then the GPS coordinates need to be simulated. The simulation is done by creating a GPS simulation file with a .dat extension. The simulation file is a capture of the RS232 data from a GPS unit that is at the location of the mapdata. For convince the simulation file name should have the same three letter abbreviation as the three letter abbreviation used above, so for our example the simulation file name would be xyz.dat. Below is a portion of a twn.dat simulation file.

```
$GPGGA,15:20:37,2347.886,N,12056.208,E,1,6,1.4-3.3,M,123,,
$GPVTG,310,T,310,M,7.8,N,7.8,K
$GPGGA,15:20:39,2347.886,N,12056.202,E,1,6,1.4-6.6,M,123,,
$GPVTG,292,T,292,M,10.2,N,10.2,K
$GPGGA,15:20:41,2347.886,N,12056.196,E,1,6,1.4-6.6,M,123,,
$GPVTG,292,T,292,M,10.2,N,10.2,K
$GPGGA,15:20:43,2347.886,N,12056.190,E,1,5,1.5-9.8,M,123,,
$GPVTG,283,T,283,M,11.8,N,11.8,K
$GPGGA,15:20:48,2347.886,N,12056.166,E,1,5,1.5-13.1,M,123,,
$GPVTG,262,T,262,M,15.3,N,15.3,K
$GPGGA,15:20:51,2347.886,N,12056.154,E,1,5,1.5-16.4,M,123,,
$GPVTG,268,T,268,M,12.9,N,12.9,K
$GPGGA,15:21:06,2347.886,N,12056.100,E,1,5,1.5-16.4,M,123,,
$GPVTG,278,T,278,M,6,N,6,K
```

Place the GPS simulation file in the C:\Program Files\Z Technology\DriveTest 2 folder.

Create a Desktop shortcut for the DriveTest application. Do a right click and select Properties on the desktop shortcut. In the "Target" box modify the line

```
from C:\Program Files\Z Technology\DriveTest2\DriveTest-2.exe
```

```
to C:\Program Files\Z Technology\DriveTest-2.exe /G xyz.dat
```

Double click the desktop shortcut. Verify that the GPS simulation is generating GPS fix data, then click the DriveTest Plot Tab. This will plot the simulated location showing the newly installed maps.